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FRIDAY, NOVEMBER 20, 1914.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

ONE-HUNDRED-AND-SIXTY-FIRST SESSION, 1914-1915.

PATRON—HIS MAJESTY THE KING.

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SESSIONAL ARRANGEMENTS.

The Opening Meeting of the One Hundred and Sixty-First Session was held on Wednesday evening, November 18th, when an address was delivered by COLONEL SIR THOMAS H. HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Vice-President and Chairman of the Council. (See pp. 6–17, below.)

PAPERS TO BE READ BEFORE CHRISTMAS.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock, unless otherwise announced:—

NOVEMBER 25.—SIR WILLIAM A. TILDEN, D.Sc., F.R.S., F.C.S., "The Supply of Chemicals to Britain and her Dependencies." SIR WILLIAM RAMSAY, K.C.B., LL.D., Sc.D., F.R.S., F.I.C., F.C.S., will preside.

DECEMBER 2.—WILLIAM REGINALD ORMANDY, D.Sc., F.C.S., "Britain and Germany in Relation to the Chemical Trade." The Right Hon. LORD MOULTON, M.A., LL.D., F.R.S., will preside.

„ 9.—WILLIAM A. YOUNG, "Domestic Metal Work of the Eighteenth Century." PROFESSOR WILLIAM GOWLAND, F.R.S., will preside.

„ 16.—SIR WILLIAM DE WIVESLIE ABNEY, K.C.B., D.C.L., D.Sc., F.R.S., "Testing Pigments for Permanence of Colour."

INDIAN SECTION.

Thursday afternoon, at 4.30 o'clock:—

DECEMBER 17.—DR. F. MOLLWO PERKIN, F.I.C., F.C.S., "The Indian Indigo Industry." SIR STEUART COLVIN BAYLEY, G.C.S.I., C.I.E., will preside.

PAPERS TO BE READ AFTER CHRISTMAS.

F. VINCENT BROOKS, "British Lithography in 1915."

HON. JOHN COLLIER, R.O.I., "Portrait Painting."

THOMAS WORTHINGTON, "The Work of the Commercial Intelligence Branch of the Board of Trade."

T. THORNE BAKER, "The Industrial Uses of Radium."

FRANK BAINES, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

G. W. HULME, "Patent Law."

W. T. THORNTON, "The Industrial Uses of Coal Gas."

D. Y. CAMERON, A.R.A., R.E., "Etching."

ROGER FRY, "Post Impressionism in Design."

C. H. SHERRILL, "Ancient Stained Glass."

WILLIAM POEL, "Shakespeare's Profession."

ARTHUR WILCOCK, "Designing for Textiles."

J. A. HUNTER, "The Textile Industries of Germany and of Great Britain."

EDWARD R. DAVSON, "Colonial Sugar Development."

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

January 21, February 18, March 18, April 15, May 13.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

February 2, March 2, 30, May 4.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

R. A. PEDDIE, Librarian, St. Bride Foundation Typographical Library, "The History and Practice of the Art of Printing." Four Lectures.

LECTURE I.—NOVEMBER 23.—*History 1450-1800.* The invention of printing—Types of the early printers—Introduction of illustrations, woodcut borders and initials—The 16th Century a period of great expansion—New styles of type—Popular books—The 17th Century not favourable to the artistic development of the art—The pamphlet and the newspaper supreme—Rigorous press laws—The 18th Century revival—Caslon type—Great printers and their styles—Baskerville, Bodoni, Didot, Ibarra—Bewick and wood-engraving.

LECTURE II.—NOVEMBER 30.—*The 19th Century.* In 1801 no machine production—Stanhope press—Type faces 1801-40—Revival of old style printing and Caslon type—Machine-made paper—Development of the printing machine—Invention of photography—Attempts at colour printing.

LECTURE III.—DECEMBER 7.—*The 19th and 20th Centuries continued.* Woodcuts of the Sixties—Invention of the half-tone—Revival of hand-press work for artistic production—Effect of revival on commercial work—Types and type-founders—Recent inventions in illustration.

LECTURE IV.—DECEMBER 14.—*The later history of colour printing.* Rise of chromo-lithography—Chromo-xylography—The Three-colour process—Collotype—Photogravure and its combinations—The offset process.

DR. F. MOLLWO PERKIN, F.I.C., F.C.S., "Oils, their Production and Manufacture." Three Lectures.
January 18, 25, February 1.

M. H. BAILLIE SCOTT, "House Building—Past and Present." Three Lectures.
March 15, 22, 29.

DAVID SOMMERVILLE, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.
April 26, May 3, 10, 17.

FOTHERGILL LECTURES.

Monday evenings, at 8 o'clock:—

PROFESSOR VIVIAN B. LEWES, F.I.C., F.C.S., "Motor Fuel." Three Lectures.
February 15, 22, March 1.

JUVENILE LECTURES.

These Lectures will be given on Wednesday afternoons, January 6 and 13, at 5 o'clock. The Lecturer and Subject will be announced later on in the *Journal*.

PROCEEDINGS OF THE SOCIETY.

THE SOCIETY was founded in 1754, and incorporated by Royal Charter in 1847, for "The Encouragement of the Arts, Manufactures, and Commerce of the Country, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the poor, to the increase of trade, and to the riches and honour of the kingdom: and for meritorious works in the various departments of the Fine Arts; for Discoveries, Inventions, and Improvements in Agriculture, Chemistry, Mechanics, Manufactures, and other useful Arts; for the application of such natural and artificial products, whether of Home, Colonial, or Foreign growth and manufacture, as may appear likely to afford fresh objects of industry, and to increase the trade of the realm by extending the sphere of British commerce; and generally to assist in the advancement, development, and practical application of every department of science in connection with the Arts, Manufactures, and Commerce of this country." In 1908 the Society was granted the privilege of adding "Royal" to its title.

FELLOWSHIP.—At the Annual General Meeting held on June 24th, 1914, a By-Law was passed authorising all Members of the Society to use the designation of Fellow.

ORDINARY MEETINGS.—Meetings are held every Wednesday evening during the Session (November to June), at which papers on subjects relating to inventions, improvements, discoveries, and other matters connected with the Arts, Manufactures and Commerce of the country are read and discussed.

INDIAN SECTION.—This Section was established in 1869, for the discussion of subjects connected with the Indian Empire. Six or more Meetings are held during the Session.

COLONIAL SECTION.—This Section was formed in 1874 under the title of the African Section, for the discussion of subjects connected with the Continent of Africa. It was enlarged in 1879, to include the consideration of subjects connected with the Colonies and Dependencies. Four or more Meetings are held during the Session.

Cantor Lectures.—These Lectures originated in 1863, with a bequest by Dr. Cantor. Several Courses are given during the Session, each Course consisting of two or more Lectures. The Lectures deal with the latest applications of Science and Art to practical purposes, and are, as far as possible, experimentally illustrated.

Howard Lectures.—The bequest of Mr. Thomas Howard (1872) is now devoted to occasional courses of Lectures on motive power and its applications.

Shaw Lectures.—Under the Shaw bequest Lectures on Industrial Hygiene are given from time to time.

Aldred Lecture.—The bequest of the late Dr. Aldred has been devoted to the establishment of an Annual Lecture.

Cobb Lectures.—Funds have been provided for occasional Lectures in memory of the late Mr. Francis Cobb.

Juvenile Lectures.—A Short Course of Lectures, suited for a Juvenile audience, is delivered to the children of Fellows during the Christmas holidays.

Admission to Meetings. Fellows have the right of attending the above Meetings and Lectures. They require no tickets, but are admitted on signing their names. Every Fellow can admit two friends to the Ordinary and Sectional Meetings, and to the Cantor and other Lectures. Books of tickets for the purpose are supplied, but admission can also be obtained on the personal introduction of a Fellow. For the Juvenile Lectures special tickets are issued.

Journal of the Royal Society of Arts.—The *Journal*, which is sent free to Fellows, is published weekly, and contains full Reports of all the Society's Proceedings, as well as a variety of information connected with Arts, Manufactures and Commerce.

Examinations.—Examinations, founded in 1854, are held annually by the Society, through the agency of Local Committees, at various centres in the country. They are open to any person. The subjects include the principal elements of Commercial Education and Music. At the 1914 Examinations 29,042 Candidates were examined. Full particulars of the Examinations can be had on application to the Secretary.

Library and Reading-room.—The Library and Reading-room are open to Fellows, who are also entitled to borrow books.

A History of the Society has lately been published (John Murray, pp. 558, 15*s.* net) and can be obtained from any bookseller. It gives a history of the Society's work from 1754 to 1880.

Conversazioni are held, to which Fellows are invited, each Fellow receiving a card for himself and a lady.

Election of Fellows.—Candidates are proposed by Three Fellows, one of whom, at least, must sign on personal knowledge; or are nominated by the Council.

The Annual Subscription is Two Guineas, payable in advance, and dates from the quarter-day preceding election; or a Life Subscription of Twenty Guineas may be paid. There is no Entrance Fee.

CALENDAR FOR THE SESSION.

The following is the Calendar for the Session 1914-1915. It is issued subject to any necessary alterations :—

NOVEMBER, 1914

1	S	
2	M	
3	Tu	
4	W	
5	Th	
6	F	
7	S	
8	S	
9	M	
10	Tu	
11	W	
12	Th	
13	F	
14	S	
15	S	
16	M	
17	Tu	
18	W	Opening Meeting of the Session
19	Th	
20	F	
21	S	
22	S	
23	M	Cantor Lecture I. 1
24	Tu	
25	W	Ordinary Meeting
26	Th	
27	F	
28	S	
29	S	
30	M	Cantor Lecture I. 2

DECEMBER, 1914

1	Tu	
2	W	Ordinary Meeting
3	Th	
4	F	
5	S	
6	S	
7	M	Cantor Lecture I. 3
8	Tu	
9	W	Ordinary Meeting
10	Th	
11	F	
12	S	
13	S	
14	M	Cantor Lecture I. 4
15	Tu	
16	W	Ordinary Meeting
17	Th	Indian Section
18	F	
19	S	
20	S	
21	M	
22	Tu	
23	W	
24	Th	
25	F	CHRISTMAS DAY
26	S	*Bank Holiday*
27	S	
28	M	
29	Tu	
30	W	
31	Th	

JANUARY, 1915

1	F	
2	S	
3	S	
4	M	
5	Tu	
6	W	Juvenile Lecture I.
7	Th	
8	F	
9	S	
10	S	
11	M	
12	Tu	
13	W	Juvenile Lecture II.
14	Th	
15	F	
16	S	
17	S	
18	M	Cantor Lecture II. 1
19	Tu	
20	W	Ordinary Meeting
21	Th	Indian Section
22	F	
23	S	
24	S	
25	M	Cantor Lecture II 2
26	Tu	
27	W	Ordinary Meeting
28	Th	
29	F	
30	S	
31	S	

FEBRUARY, 1915

1	M	Cantor Lecture II. 3
2	Tu	Colonial Section
3	W	Ordinary Meeting
4	Th	
5	F	
6	S	
7	S	
8	M	
9	Tu	
10	W	Ordinary Meeting
11	Th	
12	F	
13	S	
14	S	
15	M	Fothergill Lecture I.
16	Tu	
17	W	Ordinary Meeting
18	Th	Indian Section
19	F	
20	S	
21	S	
22	M	Fothergill Lecture II.
23	Tu	
24	W	Ordinary Meeting
25	Th	
26	F	
27	S	
28	S	

MARCH, 1915

1	M	Fothergill Lecture III.
2	Tu	Colonial Section
3	W	Ordinary Meeting
4	Th	
5	F	
6	S	
7	S	
8	M	
9	Tu	
10	W	Ordinary Meeting
11	Th	
12	F	
13	S	
14	S	
15	M	Cantor Lecture III. 1
16	Tu	
17	W	Ordinary Meeting
18	Th	Indian Section
19	F	
20	S	
21	S	
22	M	Cantor Lecture III. 2
23	Tu	
24	W	Ordinary Meeting
25	Th	
26	F	
27	S	
28	S	
29	M	Cantor Lecture III. 3
30	Tu	Colonial Section
31	W	

APRIL, 1915

1	Th	
2	F	GOOD FRIDAY
3	S	
4	S	EASTER SUNDAY
5	M	*Bank Holiday*
6	Tu	
7	W	
8	Th	
9	F	
10	S	
11	S	
12	M	
13	Tu	
14	W	Ordinary Meeting
15	Th	Indian Section
16	F	
17	S	
18	S	
19	M	
20	Tu	
21	W	Ordinary Meeting
22	Th	
23	F	
24	S	
25	S	
26	M	Cantor Lecture IV. 1
27	Tu	
28	W	Ordinary Meeting
29	Th	
30	F	

MAY, 1915

1	S	
2	S	
3	M	Cantor Lecture IV. 2
4	Tu	Colonial Section
5	W	Ordinary Meeting
6	Th	
7	F	
8	S	
9	S	
10	M	Cantor Lecture IV. 3
11	Tu	
12	W	Ordinary Meeting
13	Th	Indian Section
14	F	
15	S	
16	S	
17	M	Cantor Lecture IV. 4
18	Tu	
19	W	Ordinary Meeting
20	Th	
21	F	
22	S	
23	S	WHIT SUNDAY
24	M	*Bank Holiday*
25	Tu	
26	W	
27	Th	
28	F	
29	S	
30	S	
31	M	

JUNE, 1915

1	Tu	
2	W	
3	Th	
4	F	
5	S	
6	S	
7	M	
8	Tu	
9	W	
10	Th	
11	F	
12	S	
13	S	
14	M	
15	Tu	
16	W	
17	Th	
18	F	
19	S	
20	S	
21	M	
22	Tu	
23	W	Conversazione
24	Th	
25	F	
26	S	
27	S	
28	M	
29	Tu	
30	W	Annual General Meeting

The Cantor Lectures, the Fothergill Lectures, and the Ordinary Meetings, unless otherwise announced, will commence at Eight o'clock.

The Meetings of the Indian Section and the Colonial Section will be held at Half-past Four o'clock.

The Annual General Meeting will be held at Four o'clock.

The Juvenile Lectures will be given at Five o'clock.

PROCEEDINGS OF THE SOCIETY.

FIRST ORDINARY MEETING.

Wednesday, November 18th, 1914; COLONEL SIR THOMAS H. HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Vice-President and Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Agramonte, Albert Arthur, Assoc.M.Am.Soc.C.E., Direccion de Desagues, Dolores, Argentina, South America.

Baijal, Kewal Ram, Chandni Chowk, Delhi, India.

Baldwin, John Brake, 6, Phillimore-terrace, Kensington, W.

Barth, Jakob Christian, British Vice-Consul, Sundsvall, Sweden.

Bell, William, C.I.E., M.A., 16, Summerside-place, Trinity, Edinburgh.

Bhandarkar, Hon. Chief Justice Vasudeo Gopal, Baroda, Baroda State, India.

Bilstein, Emma L., M.D., The Mount Royal, Baltimore, Maryland, U.S.A.

Bullough, Charles John Robert, The Willows, Warwick Road, Bounds Green, Middlesex.

Burnett, Eric Vaughan, M.Inst.M.M., Villas Harrington No. 7, Camino Cintura, Playa Ancha, Valparaiso, Chili, South America.

Carr, George, 22, Clapton Common, N.E.

Clarkson, Thomas, Talara, Payta, Peru, South America.

de Quesnel, George Marinus, c/o Messrs. Edwards & Sons, 57, Moorgate-street, E.C.

Duggall, Dewan Hari Gopal, Wazirabad, Gujranwala District, Punjab, India.

Dunlap, Professor Frederick, University of Missouri, Columbia, Missouri, U.S.A.

Gould, Charles Newton, Ph.D., 408, Terminal Building, Oklahoma City, U.S.A.

Gray, Mrs. Horace, c/o Messrs. Baring & Co., 8, Bishopsgate-street, E.C.

Gunn, James, 9, Gladstone-street, Hartlepool.

Gupta, Karunakumar Dutta, M.A., B.E., 70, Lansdowne-road, Calcutta, India.

Harrison, Cecil Reeves, B.Sc., Woodcote, Chislehurst, Kent.

Hill, Lewis George, 5, Oxford-road, Acocks Green, Warwickshire.

Langton, Miss Eveline Charlotte, Underhills, Beech-road, Reigate, Surrey.

Lewis, Rev. Edward Pilcher, D.D., St. George's Parsonage, 4 Rua da Estrella, Lisbon, Portugal.

Mackillop, John Archibald, Cumbrae, Mosman, Sydney, New South Wales, Australia.

Mews, John, LL.M., 90, Westbourne-terrace, W.

Munavery, Sahib, Dr. P. M. I., Chalai P.O., Trivandrum, South India.

Narain, Parshottam, Farrukhabad, United Provinces, India.

Nash, Alfred William, Apsheronskaya, Kuban Province, South Russia.

Recke, George Philip, St. Thomas, Danish West Indies.

Rodger, Norman, 2, St. Dunstan's-hill, E.C.

Rogers-Moore, Mrs. Alice, 132, Winsor-avenue, Watertown, Massachusetts, U.S.A.

Royce, William Stapleton, J.P., The Hall, Pinchbeck, Spalding.

Sen, Hon. Rai Bahadur Nisi Kanta, B.L., Purnea, India.

Sircar, D. K., Sukchar Dyeing Factory, Sukchar P.O., 24, Purgannas, Bengal, India.

Skeet, George William, The Blue Coat School, Frome, Somerset.

Smith, Henry Lee, M.A., M.D., 2701, Calvert-street, Baltimore, Maryland, U.S.A.

Taylor, Guy Arthur, B.A., Solwezi, Northern Rhodesia.

Thornton, Horace Moore, The Richmond Gas Stove & Meter Co., Ltd., 132, Queen Victoria-street, E.C.

Westgate, John Minton, United States Department of Agriculture, Washington, D.C., U.S.A.

The CHAIRMAN delivered the following

ADDRESS.

Once again the Council of this Society has done me the honour to make me their Chairman, and it is with the pleasant and satisfactory feeling that I must have been considered as not altogether unworthy of past responsibilities that I now address you at the opening of another session. Since we last met events of world-wide importance have taken place, events which have profoundly affected the normal course of national existence in so many and in such varied ways that one turns naturally to ask the question of any institution or society dependent on voluntary support, "Well, how is it going with you?" We have had time now to think how things are really going, and it will, I am sure, be a lively satisfaction to you all to know that as regards this Society, at any rate, we have nothing to deplore—no unusual decrease either in the number of subscribers or of income generally, and that we commence another session with good hopes, a fair programme, and no regrets. The last session started full of promise, and if we accept the final report on all the varied interests and activities of the Society as drawn up by our indefatigable Secretary, I

think we may fairly claim that the promise was well redeemed. So full and so complete is that report that there is nothing that can be added usefully by me to the general matter of it. But I will claim the privilege, as Chairman, of saying just a few words about one special department of the Society's work, which may, perhaps, be considered as always open to friendly criticism. I refer to the Examinations.

It will be remembered by those of you who follow with interest the progress of the Society's work in this most important branch of it, that it was mainly through the pioneer work of this Society more than sixty years ago that educational centres were established for science and art schools. This led to the formation of school boards, which developed into local educational authorities which control elementary, and, to a certain extent, secondary education throughout this country; and it was the Society's examinations that inaugurated the local examination system which has so greatly promoted the cause of education generally. Now, at last, the Council of this Society, and those educational authorities which owe much to its pioneer work, have been united in a common effort to the same great end; and it is with the assistance and support of the London County Council's educational committee, as well as the very real and satisfactory (if unofficial) help of the Board of Education, that we maintain our present examination system.

Some alterations have been made in such details as the dates on which examinations are held and the arrangement of the syllabus which will be found fully set out in the admirable report of Sir Henry Wood to which I have already alluded, and which is to be found in our *Journal* issue for September 25th. It is not so much to the methods as to the nature of these examinations that I wish to refer. It is a subject of growing importance, for the year 1914 has been a record year for the numbers of examinees, nearly 30,000 having presented themselves for examination. This proves that the value of the Society's diploma as a passport to employment is appreciating from year to year; I think it proves also that on the whole the subjects selected for examination are those which meet the requirements of the time in all three stages of examination (the Advanced, the Intermediate, and the Elementary), and that they secure for those that succeed a real value for their time and study.

The ruling principle of all these examinations is that they should be in subjects which are useful to the commercial life of the individual and of the country. That is the ruling principle, but there are exceptions, as, for instance, the examinations in Music. As this subject falls under no particular commercial head, and appears to be amply provided for by special schools, it may possibly at some future time be discontinued. As regards other subjects, the figures given in the tables accompanying the report show very clearly to what type of the youth of the country our examinations appeal. Book-keeping is the favourite subject; then Shorthand. In both these subjects candidates are numerous and the standard of attainment is high. Arithmetic is not so popular, and it betrays some want of appreciation of its supreme importance in commercial affairs that there should be such a large percentage of failures. But it is the want of interest in those special subjects which happen to interest me individually which naturally attracts my attention most. Commercial History and Geography does not rank high in popular estimation as a subject for study at present. Nor do I expect much from the change of title and the separation of the general subject into two parts—Economic History and Economic Geography. "Economic History" suggests an academic rather than a practical study, and "Economic Geography" hardly explains in itself the enormously wide area of most important knowledge which is so necessary—and often so lacking—in our national commercial ventures.

We are just now agitating ourselves about the best methods of capturing the trade of the great commercial country with which we are at war, which is a sound and legitimate ambition. I am not an authority on commercial matters, but I may, perhaps, be permitted to express an opinion that there are certain, and, indeed, a good many, German industries which we can never hope really to "capture" till we can command cheaper labour. And when it comes to cheapening labour we find ourselves up against trades-unionism. There are others, however (and here I can speak with a certain amount of experience), which are ours to recover, which we have allowed to lapse into German hands by our want of attention to some at least of those elementary trade principles which should be included in a study of Economic Geography. Economic Geography, if it means anything at all as a study, means the careful study of countries in the matters of

geographical environment of any trade area; of the idiosyncrasies, methods, and wants of the inhabitants, the means of terrestrial communication and of intelligent converse. It must, I fear, be admitted that we do not so much trouble about ascertaining the actual wants of a community as teaching them what they ought to want. Why, for instance, in South America has more than one important trade passed out of our hands into those of the Germans? Why is it that with a people fully alive to the advantages of British seamanship the great German liners have taken so much of the first-class traffic? If you ask the reason why in the place where these things occur, you will have several reasons advanced, but they all are based on that one initial failing of ours, *i.e.*, that we do not study the wants of those with whom we are dealing, or make proper allowances for geographical conditions other than our own.

The want of appreciation shown for such a practical study as this seems to indicate that we draw our candidates almost entirely from a class which is in immediate concern for a livelihood. It is that which will lead to immediate employment which is perforce the matter of most importance. Book-keeping, shorthand and typing are the accomplishments which lead most directly to the office stool, and we must content ourselves with the assurance that we are ourselves studying the matter of local requirement, and helping those who want our help most An appeal to the results of language examinations indicates the same concern for immediate advantage, and it is questionable whether examinations in Russian, Danish, Norwegian, Swedish, Japanese, Chinese, Arabic and Hindustani should not be placed on a new basis altogether. Each candidate in these subjects has cost the Society something like 30*s*., and in the last four of these languages not one has attracted more than ten candidates during the last six years. That the percentage of failure this year in such a language as Hindustani should be 100 per cent. is melancholy reading. It means that only one candidate went up and that he failed. This is rather surprising, considering the enormous extent of English commercial industry that exists in India, and the undoubted financial attractions of that country. It rather proves again that there is a lack of both interest and ability in the teaching of Commercial Geography, when such ignorance is practically manifested of India's possibilities. It is suggested with good reason that examinations in these eight languages should be discontinued in future, unless at least twenty-five candidates present themselves.

Following the precedent established of late years in the opening address of the session, I will now turn to a subject of general interest with which I have been more immediately and specially concerned.

Amongst the minor forms of art with which this Society is concerned, and one which deserves more attention from the public than it receives, is the art of map-making. With this form of art I have been associated for many years, and I may therefore be permitted to call your attention to some of those features of it on which I consider that public attention could be usefully directed. I say this because the public is rapidly becoming more and more dependent on map information for the prosecution of commercial enterprise as much as for the proper understanding of great political and military events, to say nothing of the daily requisition of guiding maps in the widespread activities of touring about this country in motors, or about the world at large in steamers and railways. We cannot do without maps nowadays. International disputes—even if they do not culminate in war—require cartographical illustration in the daily papers; and if they do culminate in war, no discussion of military events would be acceptable for an instant without its map. And we can all read maps more or less. Even the most illiterate yokel who can ride a bicycle will have a map in his pocket, and every boy scout is taught to make a map of his own district.

The public is therefore much concerned with maps, and it is a very curious feature of this universal demand that it has been so long in developing in civilised countries. A savage often possesses the instinct of rudimentary map-making — that is to say, he has the fundamental instinct in him which certain animals (I might say all wild animals) have for direction. I remember once searching for an old and disused salt cave on the Persian coast which was said to be inhabited by devils and other unpleasant inhabitants, and which possessed extraordinary subterranean scenery of great wonder and beauty. It was a very hot and a very weary quest. An officer of the telegraph steamer of the Indo-European service was with me. We should, I think, have abandoned the search amongst the low hills which crowded down to the shore line, but that we observed a ragged and scantily

clothed individual sitting in solitude on the shore with a suspicious lump of something before him which he was guarding carefully. The practised eye of my companion observed a native craft on the blue horizon, which he rightly conjectured to be engaged in illicit salt traffic, and we at once found a way out of our trouble. The man on the shore could speak no sort of dialect that either of us knew, and we could only point helplessly to the lump of salt and to the hills, and insinuate by means of certain coins that we were not there to interfere with him, we only wanted to see where that salt came from. So with his fingers he drew a map on the sand, and he did it so well that half an hour's climbing led us into the narrow mouth of the cave, and we saw there what I believe no other European had ever seen. I am not here to talk about salt caves, or I would tell of the extraordinary beauty of that great natural cathedral of salt, with its chancel, its chapels, its screens and pillars of fantastic design and exceeding beauty, and the long subterranean gallery where, through a forest of twisted salt pillars which we lit up with blue lights, we found our way finally by a small and exceedingly narrow exit right out on to the shore once again.

The point of the story lies in the fact that precisely the same symbolism, the alphabet of map-making, came as naturally to the hand of that smuggler as it has to the hand of all map-makers since the days of Ptolemy till now. The map-making of Ptolemy is before us still, and may be studied in the archives of the British Museum. There will the map curator and secretary of the Hakluyt Society (Mr. Villiers) tell you that the very earliest maps of which there is any record are those of Claudius Ptolemeus, which were made about 100 to 150 A.D.; but the earliest copies of them to which we can refer did not exist till about the year 1400, thirteen centuries after they were actually compiled, at a time which was almost coeval with the invention of printing. Copies of his maps, which accompanied a geographical treatise, were made from time to time, one or two of which are in the British Museum. The 1400 copy contains a map which is a creditable representation of Britain not including Ireland, which is separate. The 1450 copy again leaves Ireland out of Britain and makes too much of Scotland. The 1470 copy includes Ireland with the British Isles, and is a great improvement on the preceding copies.

But there were other maps during the thirteen centuries which elapsed between the making and the publishing of Ptolemy's maps, and some of them are remarkably interesting. St. Jerome's translation of the Greek work, "Onomasticon," A.D. 388, deals with Biblical countries. A famous map of the world was compiled by a Spanish monk, St. Beatus, in A.D. 776. This makes the earth square, plants the Garden of Eden at the top of the map (which is the eastern side of it), with Eve and the serpent in orthodox relationship. The next important map is the "Cotton"—or Anglo-Saxon—map of the world, dating from about the end of the tenth century. Here Jerusalem is no longer the centre—and Taprobana, or Ceylon, is at the top. A map dating from 1200 again places Jerusalem in the centre, but from the Garden of Eden at the top there flow out five rivers, the Ganges being included. This is a diminutive map designed to illustrate a psalter, but room is found in it for a great variety of human monstrosities such as are common to all mediæval maps. These remarkable additions to mediæval mapping are really interesting as indications of the nature of the ethnographical knowledge of the time. It is quite probable that they represent the prevailing ideas of the educated—*i.e.*, of the priestly—class regarding the strange living world beyond their immediate ken. About the year 1350, and for a century later, there was a popular history in England written by a monk at Chester called the "Polychronicon," and in it there are two maps compiled in the conventional style of the day full of Biblical legends and popular myths, with Jerusalem still in the centre, and Noah's Ark resting on the Armenian mountains close at hand. The Amazons, by the way, are depicted as living in North Asia instead of South America. Some of the legends are excellent. We learn that the Tigris, the Nile, and the Euphrates all really rise in Paradise, and only make a secondary appearance in this world.

Coupled with much information of ethnological interest about men with one eye or with hairy bodies, we find these curious facts stated for the enlightenment of posterity. Germany, it is said, has a greater population than it is able to feed, whilst Ireland is both larger and wider than England; it seeks liberty but *shirks work*. One of the latest of the mediæval manuscript maps in the British Museum is a copy of a map compiled in 1459 by Fra Mauro. "Its geography," says Mr. Villiers, "shows an immense improvement on the last map of 1350, Europe being especially good."

Being 6 ft. 4 ins. in diameter, it is full of detail, and many of the old myths and legends are disposed of. Jerusalem is not in the centre of the map, but due apology is made for this fact by the learned monk, who explains that Jerusalem is really to be regarded as the centre of the earth, if we judge not by values of longitude so much as by density of population. Then followed the immortal invention of printing and the reproduction of Ptolemy's maps, which were rightly regarded as a revelation "equal in importance to all the real geographical discoveries that were being made in that important century."

Of the earliest printed maps just one or two require a short reference. There is the map known as the "Cusa" map, compiled before 1464, which is printed from a copper-plate by Cardinal Nicolas of Kuesan, which was the chief map of its time; and a map of the world in the "Insularium illustratum" of Henricus Marletus Germanus is to be noted as the first showing Portuguese discoveries. At this point in map history commence the first rudiments of modern cartography. A Dutch printed map by Johannes Ruysch first represents India as a peninsula. That was in 1507, and it indicates the gradual progress of geographical knowledge. The Waldseemuller map of about the same date introduces the New World, and further defines Portuguese discoveries; and yet another Dutch map (for the Dutch may claim to be pioneers in this branch of the art of printing), usually known as Jan Severseen's map, which undoubtedly is much indebted to the Waldseemuller map for its material, is quite a good example of early topographical art. The mountains now assume the appearance of lines of haycocks, and the trees indicating forests are all of the pointed Noah's Ark variety. Strange beasts, including an enormous elephant, stray over the continents, and monsters of the deep indicate the perils of the sea. Thenceforward the gradual evolution of the printed map passed into the hands of Italians, who took a much stronger lead in geographical illustration than in geographical discovery. Gerard Mercator, at the end of the sixteenth century, was the great map-maker of his day, and his projection (notable, perhaps, for its simplicity) is in use at the present time. Mercator gives us by far the best map of Ireland yet produced. The first panorama of London city was, strange to say, issued from a printing office in Amsterdam in 1616. It was executed by Nicolas Visscher, the engraver, and shows Bow Church in the centre; Billingsgate on the east; Hampstead on the north; and, quite naturally and rightly, the Globe theatre on the south.

So far I have dealt with some of the most interesting maps to be found in the British Museum, but I am bound to observe that the reproduction of photographs of these and other maps on the screen of the lecture-room at the Royal Geographical Society last April was hardly a success, owing to the generally illegible nature of the writing on the face of the maps and the overcrowding of detail. It was impossible in the space of one or two minutes to identify even the leading geographical features (which naturally differed widely in contour from any modern representation), and a full appreciation of the value of the information contained in them is only to be obtained by careful perusal of the originals.

It is to be regretted that the greatest geographers of the mediæval ages (the Arabs) have left so little in the shape of cartographical illustration behind them. And yet I must admit that I have found such indications of ancient geography of the East as were recorded in a form which merely gave the approximate bearings of old-world cities in parts of Western Asia from each other (without any attempt to pourtray the contour or the features of the countries concerned), a most useful guide in reviving the story of the old cities of the Persian and Afghan borders. There was, of course, the invaluable assistance of original description, and it was from this description (containing a very approximate estimate of distances between remarkable points) by the great traveller, Ibn Haukel, who travelled in the tenth century of our era, that the small and crude map was probably compiled in its original form. As we gradually developed a general geographical survey of the districts in question this little map was often sufficient to guide me to the almost unrecognisable site of some city of the past which had once been a commercial centre and an important unit in the great scheme of the mediæval Arab trade-routes.

It is an unfortunate fact that there is, so far as I know, no cartographical society in England. The art of map-making deserves more public recognition than it receives, and its gradual development from ancient beginnings is at least an historical record well worth preserving in an accessible form. There is no doubt a feature common to all these old-world maps which cannot be admitted now, but which we can only part with with regret. Pictorial imagination

played a considerable part in their production, and if there is no art without imagination then we must relegate the question of art to the pourtrayal of topographical features in our modern maps, where at least imagination still holds a certain position. But the old-world endeavour to unite ethnographical knowledge to that of more prosaic geography is no longer considered admissible. In fact, it is the extraordinary wealth of an infinite variety of information conveyed by legend and by pictorial illustration which renders the old form of mapping so interesting and so confusing. There are indeed certain details which may be considered as historically useful. We learn something of what our forefathers knew about the world they lived in. We learn what their shipping was like, even if we cannot admit their sea-born monstrosities. We have found that in some details of geographical information they possessed a knowledge of facts which have been discarded since their time, only to be revived again as correct in modern days—as, for instance, in the case of the Nile sources and the mountains of Central Africa. Even in the matter of ethnography there are certain little and apparently insignificant facts recorded in long past days on the face of the map which teach us something of the conservatism of the savage, and lead us to appreciate the mighty length of days which must have elapsed with the gradual evolution of civilisation.

I may mention one curious little incident which records the habits of certain of the coast Indians in the extreme south of South America. I do not know when first the representation of these Indians in their canoes with a fire lighted at the bottom of the canoe appears on the face of the world map. But the "Canoe" Indians still persist in this ancient method of rendering themselves independent of the camp on land, and they still take their wives and families with them, doing their cooking, and living their lives, in an open canoe. The hereditary process of paddling has resulted, too, in an enormous development of muscle in the upper half of their naked bodies, whilst their legs approach the proportions which the tail bears to the tadpole, a fact which also did not escape the notice of early voyagers and map-makers. Again, the giants of Patagonia, although they have degenerated somewhat from the days of early discovery, are still very fairly represented by the tall and athletic Tehuelchi. I was quite satisfied with the impression which they might have left on the minds of early discoverers never averse from startling discoveries, and accepting *omne ignotum pro magnifico.*

With the gradual evolution of a system of cartography which should first of all divide land spaces from water by outlining the continents and islands of the globe, and thereafter separate mountain systems from plains, and secure some representation of the hydrography of the earth by delineating the course of great rivers, there arose the imperative necessity for a form of projection of the map, the definition of parallels of latitude and meridians of longitude by means of which the true relationship of separate areas of the earth could be correctly maintained. Obviously this necessitated careful measurement of the earth's surface in order to determine its figure and to establish laws and formulæ whereby these parallels and meridians could be laid down accurately previous to the introduction of topography. Thus arose the science of geodesy, or earth measurement. Into this highly scientific and technical subject I do not propose to enter. It belongs to the domain of science rather than art, and I will do no more than just indicate its purpose in map-making. It cannot be too strongly insisted on that all sound map-making must be based on sound geodetic measurement in the first instance. Because geodesy is so highly scientific in its various processes of observation and deduction, and appeals so strongly to the mathematician, it has too often been carried out as if it were rather a matter of academic research than as the very bedrock and basis of that most utilitarian of purposes—the making of an accurate map.

To put it shortly. Triangulation, which is the outcome of geodesy, is called upon to supply the framework or skeleton on to which the topography of the body of the map has to be filled. This framework is furnished with a projected graticule system (*i.e.*, with lines of latitude and longitude correctly defined), so that the picture or plan of the country in question can be carefully adjusted by means of the points fixed by the triangulation, which are, of course, common to both the geodetic projection and the topographical map. This adjustment is the work of the cartographer. Sometimes, as in India, the cartographer and the actual topographical surveyor in the field are one and the same person. Sometimes, as in Russia, a highly practised cartographical artist is employed to take the field sheets from the hand of the topographer and translate them to the finished

map without reference to the surveyor at all. I have seen this done both in Russia and in this country. It is this latter method, doubtless, which produces the most artistic effects, but it should be remembered that topography is not only an art, but a twofold art. There is the cartographic art of translating the field map to the final sheet for publication, and there is the art, which long experience has taught me to be a heaven-sent gift (like any other artistic grace) only really given to few, of representing Nature on the field-map as she actually exists—that is to say, in all the manifold beauty of sharply-chiselled mountain, rounded hills and undulating plain, with truth and accuracy. The usual method of representation is, as I have said, conventional. Certain symbols (with which I will deal presently) must represent certain facts, but in all art there are certain conventional laws which must be followed and by which the genius of the artist is circumscribed, unless indeed he is a futurist or a cubist, or his genius has otherwise overstepped the limits of sanity.

The art of the topographer thus combines that of the painter and the engraver; he must have eyes to see, not merely the delicate indications of changing slope and relative altitude, but he must carry in the eye of his mind a fairly clear idea of what all that he sees represents in plan, what he would see in fact were he to fly over the country in an aeroplane. And then he must have the delicate touch of the true draftsman to translate his vision into black and white; a grasp of the relative importance of things and of the capacity of his scale, neither introducing confusion of detail nor omitting important features, subordinating his appreciation of relative importance to the object for which the map is being fashioned, either military or political, or simply agricultural and cadastral as the case may be. It is hardly necessary, I should hope, in these days to explain what is meant by plane-tabling. It is many years now since I had the honour of introducing the first plane-table to a military audience at the Royal United Service Institution in England, where it was regarded with the suspicion which attaches itself to the unknown, although it had been in use for years before my time both in India and on the Continent. I need hardly say that when I talk of making map pictures from Nature, I am talking of the plane-table method of making them. It is the one process which fully deserves the appellation of art, and the beauty and advantage of this system of map-making is that it appeals to the highest artistic instincts. I do not mean that an inartistic effort may be inaccurate or useless. By strict adherence to conventional rules any one may learn to make good use of a plane-table, and I may say here that no one who has learnt to use it will ever adopt any other method of representing either local plans, forest areas, mountain systems or geographically widespread areas, unless there are absolutely prohibitive conditions of climate and atmosphere.

To the true artist the call of his work is insistent. Toil and danger will be ignored for the supreme effort at seeing just that little further, of pourtraying just that little more which is to round off an effective area of map work. If you had seen, as I have, hundreds of field maps carrying geographical mapping far afield into new countries teeming with difficulties, maps, too, which bore an impress of truth on the face of them (an impression which is not to be described but which only experience can recognise), you would wonder with me at the strange fascination which the explorer's work must have for him, seeing that it will lead him to face dangers and difficulties which he might easily count as insuperable without being reckoned a shirker and occasionally beckon him on to the last great sacrifice of all his life. If accuracy is our object, then no professional cartographer, however gifted with artistic imagination and draftsman's skill, can take the place of the man who sees and knows, into whose eyes the picture of great world-spaces has entered. Unfortunately, gifts of imagination combined with draftsman's skill often make very pretty showing. Experience will enable a clever cartographer, a draftsman who has never been in the field, to represent even complicated topographical features of an imaginary character with a skill such that even an experienced surveyor can hardly detect the lies in it; and so it comes about that if a map is to be judged by its accuracy and faithfulness to Nature, apart from artistic effect, it is very often the most unattractive maps that are the best. Please remember this, and remember also that the processes of reproduction vary infinitely, and that when you look at a really beautiful production, full of harmonious light and shade, and delicate indications of graceful features where effect requires them, and exclaim "What a lovely map!" you may be merely the innocent victim of a skilful cartographer who has been backed up and perfected by a first-rate publisher.

I say this because it is undoubtedly the most effective and best-engraved maps which are accepted as the best. Indeed, I do not see that the public can judge in any other way, so the caution is really necessary. In maps especially it is not safe to judge too much by appearances.

It is interesting to observe the slow but gradual development of the art of topography from the earliest maps until now. The alphabet of the process (as I have already observed) has remained much the same. Mountains and plains, rivers and coast-lines, have been simplified and perfected so as to produce the most readable map, but the alphabet has not fundamentally altered. It is in the matter of relief chiefly that the change is noticeable. The earliest attempts at depicting mountains by pictorial elevation have given place to plan. The little groups of conical excrescences, like bands of haycocks, were by no means unintelligible, though purely conventional. Indeed, it may be doubted whether to some intelligences they are not even now a more effective illustration of hilly country than our latest and most scientific system of contouring. Between the two we may find every variety of method employed which can produce the effect required. In large scale maps dealing with comparatively small areas, and involving no great differentiation in altitude, such as rolling plains and subsidiary hills, it has long been decided that the only scientific method of depicting the country is by lines of contours (*i.e.*, lines of equal level) at definite vertical intervals. It undoubtedly has its drawbacks. There may even be a difficulty here and there in distinguishing between an elevation or a depression unless the value of the contours above the datum are distinctly stated in figures. But it is beyond dispute that for all military or fiscal purposes the contoured map is the only one admissible.

Difficulties arise when the elevations on the face of the map rise from the status of hills to that of mountains, and with the gradual steepening of slopes the delineation of contours gets closer and closer until it is impossible to introduce them on small scale maps without overlap and confusion. This applies to the many forms of geographical maps from the scale of one inch to the mile downwards, when it usually happens that some more artificial and less conventional method of illustrating mountains in plan is necessary. The difficulty is usually met by "hachuring"—that is to say, by introducing broken instead of continuous contours, and abandoning regularity of vertical interval. It is here that the artist steps in. He can cleverly introduce the effect of various shades of steepness within the limits of the steepest slopes in the map and the flattest, and give all the effect required to represent the wonderful complexity of a mountain system without committing himself to rigid lines of altitude if he has complete command of his pen and the perfectly trained eye of the true topographer for variation in hill conformation.

And if this is done with the original map of Nature spread out before him, if from some commanding eminence he can watch the play of light and shade over a rich and varied landscape, with its cunning indications of the lines of drainage (always the first to ask attention), its admirable modelling of areas which the Great Architect has moulded to the forms required by the tectonic influences of the earth's formation, here piled in the agonies of a violent upheaval there gently smoothed out with the action of wind and weather to the likeness of ripples left by the sea on its sands, or maybe uplifted to the skies in steps of broken crag and wild storm-split cliff; is it possible, I ask, for any cartographer sitting down in his chair within the four walls of an office-room to attempt a fair record of Nature's truth from rough indications brought to him by others, or to compile from a notebook a map equalling that which has been artistically written direct from the face of Nature? I have had to deal with topographers of many sorts, good and bad. I have had men who could almost indicate geological structure by topographical drawing, men who could from one or two vantage points cover an enormous area of country within the range of vision with hardly a perceptible error in distance, and a conception of what must exist in certain spaces into which they could *not* look which was almost weird. There have been men, too (natives usually), who, wandering over wide spaces of new country hitherto unexplored and unmapped, where Nature's features are often large and easily recognisable, where there is little or no complexity of artificial additions to the landscape due to human agency, where the fording of great rivers and the passage over great mountains is, perhaps, the chief feature of interest—in short, where the main object is to discover the best routes and to give a fairly accurate representation of mountain, plain, and perhaps desert on a small scale, who would in the short space of a few months cover an area of as much as 40,000 or 50,000 square miles, so

rapid and effective is the process of geographical map-making by a skilful and artistic plane-tabler with a few well-fixed points to work upon.

Do not imagine that this is mere hasty sketching, either. Here, again, the trained artist comes in. He will know at once what features are important in a military reconnaissance, and he will take care of them. A man to do this sort of work well must be no slave to conventional ideas. and he must, in addition to the artistic faculty, possess unbounded energy, pluck, and discretion. Of course, such men are rare, and it is only by a long and careful process of selection of the fittest that of all the men chosen in the first instance from native centres of education in India, or from the ranks of the Army, those who promise best are given their chance. It takes many years to make a topographical artist, just as it takes many years to make artists of other and better-known descriptions. Thank Heaven, we are getting them in the British Army at last! There is admirable work done by British military topographers in Africa, if not in the Colonies. The pity of it is that these original works of art never see the light.

The weakest link in that chain of processes which is the basis of scientific map-making, lies in the process of combining new work with old. Owing to the obvious necessity for publishing maps in sheets, it is impossible to secure perfect homogeneity in the matter of accuracy within such definite limits as the sheet imposes. Even in the best maps, let us say the Ordnance one inch per mile sheets, which have been perfected by years of careful surveying at the cost of great expense, we cannot be sure that the up-to-dateness of the map is absolutely equal in all parts of it. Indeed, we may be much more sure that it is not. People ignorant of the processes of map-making can have little idea how much the process of revision enters into the matter. The rapidity with which fresh artificial geography in the shape of roads, railways, houses, etc., springs into existence, combined with the action of wind and weather in changing the face of Nature, taxes all the resources of the Ordnance Survey to cope with it. And it is almost impossible to maintain a high standard of up-to-date mapping which is applicable to any one map in a sheet of any size all over the face of it. But when we come to the class of mapping which we include under the term geographical, *i.e.*, wide areas depicted topographically on small scales within the rigid lines of a restricted sheet, these variations in quality of accuracy become far more pronounced and more important. No one but the compiler (who keeps the record) can possibly say what is the exact value of any one portion of the map, how far it is to be trusted in the business of conducting military affairs or the international arrangements of boundary settlements.

A naive belief in the accuracy of a printed map compilation (which can only be compared to the faith of a child that everything must be true that is to be found in print) has foundered many a high political programme, even when the geographical features which may form the basis for a treaty have been correctly shown as they existed at the time the map was made. The face of the earth changes and locally changes very fast. Slight errors which we find in dealing with Ordnance Survey maps we find exaggerated tenfold in our geographical maps of Asia, Africa, or America.

We will take, for example, the geographical mapping of those far countries with which I am best acquainted, and for which mapping I have been partly responsible — let us say, the maps of the northern borderlands of India, of Afghanistan, Baluchistan, and Persia, with parts of North-East Africa and South America. In the compilation of those maps every class of work has been utilised, good, bad, and indifferent, and it has been obviously impossible to show on the face of the finished and printed map to what category any particular portion is to be referred. The artistic beauty of some of the originals is blurred and ill-treated by the process of publication. The elementary character of others has been disguised by efforts of imagination, and the level value of the printing process is accepted as representing a level value of general accuracy. It may be accepted, as a rule, that the most trustworthy part of the map is that furnished by the professional surveyor and explorer, and such work is generally easily recognised by the expert, though not so by the public. Then follows in value an infinite variety of the amateur efforts of travellers (I am quite aware that many of them would resent the term "amateur," but in my opinion the gap is not to be bridged which separates the two classes), and it is by no means the latest traveller's work that always proves the most trustworthy. We are all of us acquainted with the general style of the explorer's map of half a century ago, the long zigzag line representing his route, the occasional bearings recorded to distant peaks, the small wriggles indicating the rivers crossed, and possibly an arrow to show the direction in which they flowed, and beyond this a broad sheet

of unspoiled white paper. That is no longer the style of the plane-tabling explorer, who sketches all that he sees, who gets to every commanding eminence he can reach, and will spend days in reaching a point that would have been passed as insignificant in earlier times.

And yet all honour to those past pioneers in the work of geographical surveying, for with infinitely inferior means at their disposal and inferior education, they often made up by persistent steady effort, painstaking accuracy in what they recorded, and an almost weird capacity for all-round observation, for the want of scientific means for square surveying. I have in mind the work of some of the officers employed during the Afghan Campaign of 1838–42. It was restricted and narrow in the output, but so infinitely careful in detail that it was a pleasure to go through it all again and to realise by the light of present knowledge what it must have cost them in anxiety and labour to achieve such work. It is by the light of this earlier work that one realises how the geographical face of Asiatic lands can alter in a few generations. Where roads are but tracks they may shift their position almost indefinitely to suit new passes or fords, new centres of trade to be tapped, new villages sprung up with the extension of cultivation. As for the rivers of India, unless confined within rocky beds, their notorious irresponsibility in finding new channels and shifting their channels, drying up altogether here and breaking out with new springs there, is a perpetual source of anxiety to the engineer and of litigation to the landowner.

It is the same all over the uncivilised world. The eccentricity of river action nearly led to disaster in South America, and the same difficulty will give us trouble in Africa without doubt. No need to elaborate this propensity of our earth world to change its face, or of its more primitive inhabitants to change their habitations and call them perpetually by new names. I only refer to it as a caution to map critics.

I have said a word or two indicating that the gift of imagination must still have its place in map-making. This may sound almost immoral, although it is but a page from past records, and yet I have come to the conclusion that if the public is asked to exercise imagination in reading the map, the map-maker must meet the public half-way. It is still, of course, in the domain of geographical mapping where the conformation of the ground is partly well known, partly indifferently known, and partly conjectural, and where the process of map reproduction renders it exceedingly difficult to distinguish between these relative areas, that imagination must here and there be called upon to supplement actual knowledge. In the ordinary business of rapid geographical map-making in the field, the map-maker would prove himself to be but a sorry performer if he wasted valuable time (and time is almost always restricted) over features which could be of no practical importance whatever, whilst he neglected matters that were significant, either from the commercial, military, or political point of view. Or it might happen that whilst money is forthcoming to support the surveying of the infinite complications of mountain formation where that formation includes cultivated valleys or possible routes leading across passes to more important fields beyond, there is no warrant for expenditure over the wide stretches of snow-field and curving glaciers, the ice-ribbed cliffs and crags that lead up in shining steps to the thrones of the gods on the snow-clad peaks. And thus it happens that if the map-maker were to confine himself to absolutely what he knew to be true in the delineation of mountain and valley, or of rough desert areas wherein no living creature moved, he would simply leave large white blanks in his map which might in themselves be most misleading.

It used to be the fashion to leave such blanks, but in my opinion it is better to introduce mountains or deserts where they are known to exist, to indicate all that can be seen from a distance, to trace out from afar the probable origin of glaciers and mountain torrents, or to show by conventional forms the trend of the wind-blown sand-hills, than to make no sign at all. The part of the map which is conjectural should, of course, be carefully indicated; but there is doubtless a tendency on the part of enthusiastic explorers to consider much of these conjectures as certainty, and to make no specific distinctions between what they know and what they think they know. In this way it often happens that succeeding explorers in the same region are apt to condemn the work of their predecessors from want of knowledge of the exact nature of the different parts of that work. It is not enough in these days that an explorer should have previous map information of the region of his researches if he is not also exactly informed as to the accuracy and trustworthiness of every part of such map. I may say just a word here about map criticism. It is a most common thing for even intelligent travellers

passing over a country with a map in their hands to report that they found the map all wrong. Indeed, it is almost invariably the case. Now, in the case of expeditions into partially known lands, it is only the expert who can say whether the criticism is a just one or not. In most cases it is not, for the simple reason that ordinary travellers have no means of identifying their position, and do not know exactly where they stand; whilst, as regards place names, although they may succeed in identifying the position named, they are at the mercy of native guides and interpreters for their own information. In most cases the new view of the proper name for a village, a mountain, or a river, has no better foundation than the old one, probably not so good.

This, however, is beyond the usual experience of the British tourist in England. He will take, say, one of Bartholomew's half-inch maps in his hand, and still he will blunder hopelessly as to his exact position if he is travelling at any speed, and yet he will be equally certain that the map is wrong. I have already explained that there are bound to be weak spots in every guide map of this sort—some of them due to the processes of printing and reproduction, some due to want of revision, and the tourist may likely enough hit on one of them; but in the great majority of cases I have noticed that the criticism comes from want of identification of exact position. Even in the matter of that identification the traveller has only the map he is criticising to help him. He is not an expert surveyor with instruments and knowledge enough to render him independent of the map.

From what I have said you will gather, no doubt, that whilst professional map-makers are often hampered and sometimes misled by the results of the amateur explorer's observations, they are infinitely indebted to the few who will carefully make themselves acquainted with previous records touching the country they explore, and taking all the data they can get from professional sources, and a proper instrumental equipment, will endeavour to supplement geographical work in those remote regions which are partially known and conjecturally mapped.

I should like to say a word in conclusion about improving, if that is possible, the usefulness of the guide maps that are in everyone's hands in these days. There is one matter about which experts disagree more or less, and it is one on which I think the public might well express an opinion. It is the fashion now to indicate successive planes of elevation by flat tints, and the ordinary application of colour for that purpose is in shades of green for the lower elevations, rising into brown which deepens with the altitude. So well known is this system that I think it may be considered to have established a fair claim to permanence, so far as British maps are concerned. For my own part, I can imagine nothing better for ordinary touring maps. But difficulty arises when the altitudes are great, rising to many thousands of feet as in mountainous regions. Here it is admitted that no one universal system of colour-printing is satisfactory. This is not an unimportant matter, for it directly affects geographical education, which now is so largely assisted in schools by wall maps. In the effective preparation of these we want the opinion both of teachers and of artists. I have seen school maps where the mountains are depicted in bands of fiery red, which may certainly be effective in catching the eye of a pupil, but which, being quite apart from and beyond any scheme of Nature's colouring, are to me more distracting to the eye than persuasive to the mind. The impression of climbing up a red-hot staircase to meet the cooling influences of snow at the top does not seem in harmony with the general fitness of Nature's schemes. It is, indeed, in the hope of attracting more public attention to one of the utilitarian branches of an art that is not generally attractive that I have ventured upon offering these few words about maps to the Royal Society of Arts in the opening address of the session.

After delivering the Address, the Chairman presented the Society's medals, which were awarded for papers read during last Session.

At the Ordinary Meetings:—

P. Chalmers Mitchell, M.A., D.Sc., F.R.S., Secretary to the Zoological Society of London, "Zoological Gardens."

John Charles Umney, F.C.S., "Perfumery."

Arthur Fell, M.P., "The Channel Tunnel."

W. S. Rogers, "The Modern Poster: its Essentials and Significance."

Edward F. Strange, R.E. (Hon.), "Japanese Colour-prints."

William Reginald Ormandy, D.Sc., F.C.S., M.I.Automobile Eng., "Motor Fuels, with special reference to Alcohol."

R. A. Peddie, "The History of Colour Printing."

E. Halford Ross, M.R.C.S., "House-flies and Disease."

John Clarke Hawkshaw, M.A., M.Inst.C.E., "The Early History of the Channel Tunnel."

In the Indian Section:—

COLONEL T. HOLBEIN HENDLEY, C.I.E., "Indian Museums: a Centenary Retrospect."

MRS. PATRICK VILLIERS-STUART, "Indian Water Gardens."

GEORGE C. BUCHANAN, C.I.E., M.Inst.C.E., Chairman of the Rangoon Port Trust, "The Port and City of Rangoon."

SIR JAMES M. DOUIE, K.C.S.I., "The Punjab Canal Colonies."

In the Colonial Section:—

SIR ROBERT WILLIAM PERKS, Bart., Assoc.Inst. C.E., "The Montreal, Ottawa, and Georgian Bay Canal."

SIR BOVERTON REDWOOD, Bart., D.Sc., F.R.S.E., before proposing a hearty vote of thanks to the Chairman for his excellent address, said he desired to say that it was very satisfactory to find the venerable Royal Society of Arts pursuing the even tenor of its way under the conditions which existed at the present time. It was true that the Press Bureau, with paternal solicitude for the mental well-being of the people of the country, administered to them war news in homœopathic doses; nevertheless the newspapers, morning and evening, were largely filled with particulars of engagements at the various points at which warlike operations were proceeding, and it was scarcely possible, therefore, for anyone to avoid assimilating a good deal more of that sort of information than was good for his nervous organisation. He ventured to say that there was no better sedative for overwrought nerves than to take an active part in the work of such a Society as that in connection with which the present meeting was being held. He had had the advantage of listening to many addresses from previous Chairmen of the Council, but he had never listened to a better one than that which had just been delivered. Some people professed to be able to get a good deal of enjoyment out of the study of the pages of "Bradshaw's Railway Guide." That was an exceptional or acquired taste, but there were very few people who had not an inborn love of maps, and it must therefore have been of the greatest interest to those who had been fortunate enough to hear the address read to learn the process of evolution through which the art of map-making had passed until it had reached its present state of perfection. There was, admittedly, no one better qualified to deal authoritatively with the subject than the Chairman, and very few who could have invested it with the charm with which it had been presented. He was, therefore, sure he expressed the sentiments of all present when he proposed that a very cordial vote of thanks be accorded to the Chairman for his most interesting address.

THE RIGHT HON. SIR MORTIMER DURAND, G.C.M.G., K.C.S.I., K.C.I.E., in seconding the motion, said he had listened to the address with something more than pleasure, because the Chairman was a man who knew how to do things and how to write about them afterwards a very rare combination. Everything he wrote was clear, eloquent and comprehensive. Nevertheless, the chief impression left on his mind by the address was a painful one. He had always had the most simple and touching faith in the modern map, but Sir Thomas had shaken that faith very sadly. He remembered some twenty-five years ago, during the conduct of some negotiations with the Amir of Afghanistan, appealing to the maps in support of his contentions, but the Amir replied, "All your maps are wrong." The Amir proceeded to sketch on a sheet of foolscap, with a pencil that was blue at one end and red at the other, a map of his own which made one's brain whirl; but he (Sir Mortimer), after listening to Sir Thomas's address, was beginning to think that possibly the Amir had some reason on his side, because he was afraid that the Chairman was largely responsible for some of the maps that were impugned.

The vote of thanks having been carried by acclamation,

THE CHAIRMAN, after thanking the audience for the cordial way in which the resolution had been received, said he was particularly pleased to hear Sir Mortimer Durand's remarks, because he did not think there was a better judge of maps to be found anywhere in the country.

COTTON CULTIVATION IN UGANDA.*

Cotton is grown on all kinds of soils in Uganda. The black loams have been considered the most suitable, but the satisfactory growth of cotton is governed more by climate and season than by any nice distinctions in soils. Giving the black loams the preference where they occur, we may say that all the soils of the Protectorate are capable of producing good crops of cotton provided that the soil is in a condition favourable to plant-life.

As regards climate, there are districts which, on account of their elevation, are too cold for the satisfactory ripening of the crop, and others which are so dry that a sufficient rainfall is not to be depended upon. There is, however, a large area of the Protectorate which is eminently suited to the crop. In the first class of our cotton areas are the Teso and Lango districts, a great portion of the Bukedi and Busoga districts, the sazas of Bulemezi, Buruli, and Bugerere in Buganda Kingdom, and that part of Bunyoro which borders on the Nile. The crop may also be expected to give satisfactory returns throughout the greater part of Buganda.

* Issued by the Uganda Protectorate Department of Agriculture.

Variety.

Uganda cotton is the progeny of some American Upland seed imported into the country in 1910. The Department of Agriculture is constantly at work on the improvement of the staple, and issues the best seed available to cultivators. The whole seed supply is under the control of the Department of Agriculture, and only seed issued by or approved by the Department may be sown.

Selection of Soil and Site.

Having regard to what has already been said on the subject of soils, the selection should be governed by the usual considerations — that is, the best available should be chosen, and a waterlogged or thin stony soil avoided. The same remark applies to situation, which should not be more windswept than can be avoided.

It has been a common practice in Uganda to clear virgin land for cotton every season; this is quite unnecessary, and provided that the land has not been exhausted in any way, there are advantages in selecting land which has been cropped, as the soil can be put in a good state of cultivation with less trouble and expense. If groundnuts or beans are taken as the first crop on newly opened land, they make a good preparation for cotton.

Preparation of the Field.

The preliminary cultivations are of the utmost importance, and should be done thoroughly.

The land should be dug over or ploughed to a depth of 9 ins.; in the case of land which has already been cropped, the preliminary cultivation may be as deep as possible, but on virgin land it is not advisable to attempt to go deeper than 9 ins. In either case the land should be thoroughly cleaned, and all roots of grasses, etc., removed.

Time of Sowing.

The seasons in Uganda are so variable and local as regards rainfall, that no definite time can be fixed for the sowing. This is a matter on which each individual planter must use his judgment. The general sowing season extends from April to July, according to the occurrence of rain.

Among the natives of the Teso district the Department has introduced a system of double sowings. Each native cultivator has two plots, one of which he sows in April or May and the other in June or July, thus ensuring that at least one of his plots adapts itself to the vagaries of the season. In a favourable year both of his plots may do well, and he profits accordingly.

Distance of Sowing.

Cotton is sown in rows. There is no hard and fast rule as to distances, and these may be varied according to the capabilities of the soil. It has been found by trials that a distance of 4 ft. between the rows and 1 ft. 6 ins. between the plants in the rows is, on the average, the most suitable distance, and this has been adopted as the standard for native cultivators.

Method of Sowing.

The seeds are dibbled by hand at a depth of about one inch. It is customary to sow several seeds to each hole; this ensures a good stand of plants throughout the field, and the superfluous plants are pulled up later, one plant being left to each hole. The ratio of germination is invariably high, and an allowance of three seeds per hole will be found ample.

As soon as the young seedlings appear above ground any blanks should be re-sown.

In some countries cotton is sown on ridges. No advantage has been found in this system, and the universal practice in Uganda is to sow on the flat.

Singling.

The singling should be done when the plants are about 6 ins. high and have five or six leaves. The labourers should be instructed not merely to leave one plant out of each clump, but to leave the best plant of the clump.

It is better to make two operations of the singling; the first time the labourers should leave two plants standing, and a fortnight or so later the field may be singled. This process entails a little more work but ensures a good stand.

Cultivations.

The number of times that the field must be cultivated will depend partly on the season and largely on the thoroughness of the initial cultivation.

The field should be hoed over at the time of singling; the number of subsequent cultivations will vary considerably. The field must be kept clean, but it should not be forgotten that there are other objects in cultivation besides the eradication of weeds. It should be the object of the grower to maintain a good mulch—that is, to keep the top two inches of the soil well stirred and in a good condition. More especially is this of importance during dry weather, and, if the field is cultivated at the end of the rains, the resulting mulch will be of great assistance to the plants during the dry spell. It must be remembered that whereas the original cultivations before sowing should be as deep as possible, all subsequent cultivation should consist merely of surface hoeing.

Picking.

Picking will commence about five months after sowing, and the picking season will extend over several months, the number of pickings varying with the weather conditions experienced. The pickers should be provided with bags with two pockets, so that the clean and dirty cotton may be kept separate. They should be taught to seize the boll with one hand and take out all the cotton with one motion of the other hand, otherwise they will pick each lock separately and so waste time. After picking, the cotton should be put out in the sun for a day to ensure its being quite dry before it is stored.

DISEASES AND PESTS.

The cotton plant is subject to a large number of diseases and insect pests. A variety of these ills will be found in any cotton-field during most seasons, but it is only occasionally that any particular pest becomes a serious menace to the crop.

The best precaution against such of these diseases as are physiological or of fungoid or bacteriological origin lies in good farming. Damage caused by insects may be materially reduced by attacking the early generations, many of which can be hand-picked and their multiplication thus hindered.

THE FOOD VALUE OF ACORNS, HORSE CHESTNUTS, AND BEECH MAST.*

Acorns, horse chestnuts, and beech mast may all be used as food for stock if fed with discrimination, though there is evidence to show that if carelessly fed the results in the case of acorns and beech mast may be serious. Relatively, however, serious accidents are so few that there is no reason for avoiding these foods in times of scarcity, and the Board feel that at the present time full use might be made of them, subject to their being unaltered by moulds or ferments, and to their being given only in small quantities in conjunction with other foodstuffs.

Owners and occupiers of land who do not themselves have these products collected would probably gladly allow cottagers and others to gather them for their own use.

ACORNS.

It is an old-established custom in Great Britain to collect acorns for pig-feeding, or to turn out cattle and pigs to gather up the fallen fruits. Centuries ago, when fewer varieties of crops were grown, the rural population found the yearly yield of acorns of great value for feeding their pigs. In some parts of the country it is still the custom to collect acorns for the pigs, for feeding which they are commonly valued at about 1*s.* per bushel, though their real food value is probably much higher.

During the last thirty or forty years, however, there has apparently been a growing reluctance to utilise acorns to the extent which formerly prevailed, and this may be in part due to the fact that large numbers of cattle under three years old have been lost owing to the so-called "acorn poisoning."

There is some risk of injurious effects from the consumption of large quantities of acorns by young cattle, though not apparently by cattle over three years old, sheep and pigs. The "poisoning" does not usually follow on the consumption of acorns in small quantities, but is commonly due to full meals of acorns without adequate supplies of water in periods when there is a dearth of herbage. The evidence shows that when acorns, in sound condition, are given judiciously, in small quantities only, they are unlikely to cause any ill-effects, but are a valuable addition to the ration, more particularly in the case of pigs, but also for sheep and adult cattle.

The food value of acorns lies chiefly in the large quantities of digestible carbohydrates which they contain. On this account they would form a useful supplementary food to green fodder, and to such foods as are rich in protein, and they could, to a certain extent, replace in the ration cereal and other foods rich in carbohydrates.

Fresh acorns should preferably be fed only to pigs, sheep, goats, and adult cattle in moderate quantities, along with other foods, and the change to the ration containing acorns should be effected gradually. It is not safe to feed fresh acorns in any considerable quantity to pregnant sows, dairy cows, or young cattle. Where pigs are driven into woods they must be given green or other supplementary food which will supply a sufficiency of phosphates and lime, necessary substances which are present in acorns in only small quantities. Special care must be taken to withhold cattle from pastures where unripe acorns have been blown down.

Drying the acorns improves the flavour and feeding value and reduces the risk of illness, and acorn meal, prepared by grinding the kernels after drying and then separating them from the cracked husk by sifting after roughly crushing, has a feeding value approximately equal to that of barley meal and oat meal. Care should be taken not to feed any mouldy acorns.

NOTE.—The following are the symptoms of "acorn poisoning," which, as has been explained, affects young cattle almost exclusively:—Progressive wasting, entire loss of appetite, diarrhœa (which may sometimes be tinged with blood), discharge of an excessive quantity of pale urine, sore places inside the mouth, discharge from the nostrils, and also from the eyes, which are always sunken, giving the animal a peculiar haggard expression. No fever is present from first to last, but, on the contrary, the temperature is commonly below the normal standard, though in some cases stated to be above the normal.

HORSE CHESTNUTS.

The quantity of horse chestnuts that may be fed to animals need not be limited from considerations as to any poisonous effects, as they do not appear to be poisonous.

The following quantities of fresh and unprepared nuts have been fed per head per day:—½ to 1 lb. to sheep, or up to 2 lbs. to fattening sheep; 4 to 10 lbs. to dairy cattle; about 12 lbs. to working oxen; and about 6 lbs. to horses. They may be fed whole, but should preferably be crushed; they should on no account be fed unprepared if they are mouldy. It is doubtful whether pigs can be induced to eat them unprepared, but in the form of meal pigs have been given up to 1¼ lb. with good results.

* Special Leaflet No. 9, issued by the Board of Agriculture and Fisheries.

Wherever practicable, and especially where it is intended to feed quantities of chestnuts to stock, chestnut meal should be prepared from the kernels after removing the husk. The nuts can be dried in a hop oast by using a good fire, or in any oven in which the temperature can be raised to about 160° F. After drying and partial crushing the greater portion of the outer husks may readily be removed and the residue ground to a meal of any desired fineness. Auld remarks that to obtain a meal of better flavour, to which animals can be sooner accustomed, the nuts, after drying and partial crushing, may be allowed to soak in cold water overnight, after which they are boiled for half an hour or so; the water is then rejected, and the residue is dried, partially husked, and reduced to a meal as before. Horse chestnut meal prepared in some such way would be a fairly concentrated food, and would prove very useful for fattening purposes or for store cattle once the animals can be accustomed to the food. Based on a comparison of starch equivalent 1 lb. of horse chestnut meal would be equal to 1 lb. 1 oz. of feeding barley, or 1 lb. 4 ozs. of oats, or 1 lb. 8 ozs. of bran, or 2 lbs. 5 ozs. of good meadow hay.

Both the whole chestnuts and the meal are chiefly valuable on account of their content of digestible carbohydrates. They would form a suitable supplementary food to watery foods, *e.g.*, green fodder, silage, root leaves, or beet pulp, and they would also be useful when feeding damp food or green food wet with rain. On the other hand, chestnuts are somewhat astringent, and if taken in large quantities unaccompanied by watery foods have been known to cause digestive disturbances, particularly stoppage. The addition of salt not only prevents this, but has the effect of making the ration more tasty. Oil cakes rich in protein, hay, and straw seem suitable complementary foods in addition to the watery foods mentioned above. Owing to their high total digestibility, chestnuts would probably increase the total digestibility of a ration in which they are fed as a supplementary food. Where animals cannot at first be induced to eat the nuts or meal, a little treacle may be added to mask the bitter taste.

BEECH MAST.

Comparatively little seems to be known as to the value of beech mast as a feeding stuff, and no exact experiments appear to have been carried out with it. It may be said, however, that beech mast should not be fed to horses, which are susceptible to a deleterious constituent of the mast, and that sheep will either not eat the mast at all, or can only be made to do so under compulsion. Further, the husk contains so high a percentage of crude fibre that the whole mast is unsuitable for feeding purposes, and only the kernel should be fed. A fine oil is obtained from the kernel, and hence the question of feeding the residues (or cake) might arise.

The shelled kernels and shelled cake are rich in albuminoids but have a low content of carbohydrates, so that suitable complementary foods would be those poor in protein but rich in carbohydrates. The small quantities of tannin present are negligible from the feeder's point of view.

Beech mast has been fed to cattle and pigs without harm, and it is stated that cattle are not susceptible to the constituent which has been found harmful to horses. Poultry, especially turkeys, readily eat beech mast, on which they fatten quickly.

Beech mast which has become damp or slightly mouldy should be cooked before feeding. Plenty of drinking water should be allowed to the animals.

THE HYDRAULIC MINING CARTRIDGE.

In the course of a paper on "The Uses of the Hydraulic Mining Cartridge," read before the Society of Engineers (Incorporated) on November 2nd, Mr. James Tonge stated that the disadvantage and danger of employing explosives to excavate rock and other material from confined places had long been recognised. The effect of blasting could not always be confined to the area desired to be dislodged, and the use of explosives must involve either the risk of accident through insufficient charge or the production of misapplied energy.

Many mechanical substitutes for blasting had been devised to avoid these drawbacks, the simplest form being the wedge. The stub and feather and the multiple wedge had been used as improvements on the simple wedge; and in coal mines wedges invented by Bidder, Burnett, Shreeve, and Hall had been employed. These all had proved impracticable, and, except in the case of the simple wedges, were now practically out of use. The hydraulic mining cartridge was not worked on the principle of a wedge. It consisted of a steel cylinder containing a number of telescopic pistons operating at right angles, which expanded upon the application of water from a hand hydraulic pump attached to the cylinder by a steel pipe. The cylinder was placed in a suitably drilled hole, and the rock removed gently.

As the operation proceeded it was possible to see the rock slowly fracturing, and at the conclusion of the operation the débris were left in good condition suitable for speedy removal. Explosives could not be made to take advantage of the natural bedding and cleavage of rocks, their violence being expended on "hacking through" to the nearest unsupported edge. With the hydraulic cartridge it was possible to excavate greater areas at one operation, the weight of the detaching strata itself being used to increase the scope of the operation.

The hydraulic cartridge was used to a large extent in mines for (*a*) commercial reasons; (*b*) safety. The machine had been found equally applicable to work either in open trenches or under water. In considering the excavation of concrete beds by a method which would not involve

explosive blasts, it was necessary to remember that there was a wide difference between concrete and stratified deposits. In the latter case there was only slight crushing of the rock before the applied pressure caused the mass to bend and crack; whereas in concrete considerable pumping had to be employed without any apparent effect before the fracture appeared. This was due to the crushing or compressing that the mass would withstand before finally breaking. Further pressure, of course, increased the magnitude of the break.

It was found that concrete foundations were particularly well suited to the application of this machine, horizontal and vertical shots being arranged at intervals all round the bed and pumped off in turn. About 3½ tons of material could be excavated per thrust.

PIEDMONT: ITS AGRICULTURE AND INDUSTRIES.

Major Percy Chapman, who is now Consul-General at Turin instead of Florence, where he was formerly quartered, has signalised his new appointment by writing an interesting report on the agriculture and industries of Piedmont for 1913. The entire region consists of plains, which occupy one-fourth of the whole area, 6½ million acres of which are under cultivation. The highest regions of the Alps consist, of course, of glaciers and rocks, below which are pastures, first bare, afterwards shrubbed by rhododendrons, and then by larch, fir, and pine woods, and lower down by beech, chestnut, and oak woods, intermixed with lime, maple, ash, birch, cherry, willow, alder, acacias, and elm trees. Unfortunately most of the luxuriant woods which are said to have once existed on the Alpine and Apennine slopes have been despoiled of their best trees without any regard for re-afforestation. The Piedmontese plain consists to a great extent of Alpine diluvial soil, which in the more elevated regions presents itself to the tiller in a denuded state, while in the lower zones it is covered by alluvial strata carried down by numerous rivers.

As far as regards emigration, the last statistics are those for 1911, when the total number of Piedmontese who emigrated abroad was 52,365, the greater part to various European countries and those bordering on the Mediterranean.

During the last twenty years remarkable progress has been observable in all branches of agriculture, the consumption of fertilisers having greatly developed, and the use of agricultural machinery being now met with particular favour. The imports of the latter were valued in 1904 at £248,620, while in 1913 the same item had risen to £759,103. Modern methods of culture and rotation of crops are being generally adopted, with the result that the production of cereals and forage has more than doubled, and land has increased in price by about 25 per cent., and in some communes by over 40 per cent. Government experimental farms, agricultural associations, agrarian boards, and particularly ambulatory schools (*Cattedre Ambulanti*), through their exertions and teachings, have helped materially to bring about the increased production. But still much remains to be done. Live-stock breeds require improvement, silviculture is not sufficiently cared for, pastures might give much larger yields, fruit-growing is capable of further improvement, and scientific poultry breeding is almost unknown.

With regard to exports, Turin is an important market for wines, especially Barolo, Asti, and the popular vermouth. Cuneo is the largest market in the world for cocoons, and the best in Italy for chestnuts. The Vercellese district and Novarese plain form a centre for rice-growing which extends over 617,500 acres. Irrigation is much developed throughout all Piedmont, and more especially in the Province of Novara, Turin, and Alessandria, and on the hills of the Province of Cuneo, where canals belonging to the State have been in existence from olden times. The largest canal is the Canale Cavour, measuring fifty miles in length and irrigating an area of about 750,000 acres. Vine-growing has in Piedmont considerable importance, the area under vines being 719,511 acres, while the Province of Alessandria ranks as the finest wine-producing district among all the provinces of Italy. Among the miscellaneous rural products may be mentioned the white truffle of Piedmont (*Tuber magnatum*), which is said to enjoy exceptional renown both for flavour and perfume. It is stated that Napoleon I. and Rossini preferred it to any other. In times of scarcity the Piedmontese white truffles reach the extravagant price of 60 lire (£2 8*s*. per kilo.). The white truffle is found in close proximity to the roots of the oak, willow trees, and poplar, but never beyond 1,640 feet above sea-level. The search is made by means of dogs, chiefly water-spaniels, or pigs. In Italy, truffles as well as mushrooms are considered a free produce of the soil and belong to the finder. Another characteristic product is that of vermouth, the origin of which is very ancient, being mentioned as far back as the time of Cicero. It was manufactured in Tuscan farmhouses as early as the beginning of the eighteenth century, and was even then known by the name of vermouth. It was probably imported from Tuscany in 1786 into Piedmont, where it gradually became known and appreciated, and large factories were started, some of which at present cover very extensive grounds, and possess numerous storehouses and vaults.

BASKETS USED BY GERMAN ARTILLERY.

The American Consul-General at Coburg states that his attention has been directed to a new feature of the basket industry at Coburg. This is a full line of baskets made in various sizes and shapes for the army, and used in transporting shells and

cartridges. The largest-sized baskets are made to contain one shell each, such being used for coast artillery. Other baskets are made in various shapes, with receptacles for shells and cartridges. All the latest patterns of baskets for transporting shells are made with eight strips of hard wood, four on the outside and four on the inside, extending from the top to the bottom of the basket. The outside strips are to protect and strengthen the basket, and the inside ones to keep the shell in place. Within these baskets are placed two strips of canvas belting, attached to a circular leather bottom upon which the shell rests. The outer ends of the strips are fastened together, making a sort of handle by which the shell is lifted from the basket, the bottom resting on the leather circle. Baskets are made in various sizes to suit the shells, and others with divisions to accommodate cartridges and explosives. The wood with which these are strengthened is very hard and tough, and is supplied by the Government. The baskets are manufactured in large quantities, and are kept filled with shells and cartridges at the artillery depots. During manœuvres, and in case of war, the baskets containing the shells are loaded on the railway trains and taken to the front for use. Through the use of the baskets the shells and explosives are protected from contact with hard substances. The baskets containing shells for field artillery stand upright in the gun-carriages. Within the last few years upwards of 1,500,000 baskets have been made for the German Army. Before the war large deliveries of baskets were made to Austria and Turkey.

ARTS AND CRAFTS.

Women's Work in Arts and Crafts.—It is, perhaps, inevitable in the general upheaval caused by the war that craftworkers as well as other people should try to increase their business by putting forward any plea that occurs to them. But, when all has been said, it is to be doubted whether the suggestion of the promoters of *The Englishwoman* Exhibition of British Arts and Handicrafts, to the effect that since British handicrafts have for many years suffered from the competition of machine-made articles from Germany there is now an unprecedented opportunity for the revival of our ancient and beautiful arts and crafts, has very much to commend it. To tell the truth, German competition of any kind has had but little influence on craftwork in this country. The real rivalry has been between British and German manufactures, and it is British trade and design, rather than craftsmanship, which may hope in the long run to benefit by the war. Our imports from Germany have not in the main belonged to those types of expensive machine-made goods which may be taken as competing seriously with handicraft. German goods with any artistic pretensions have generally been bought because they were cheap, not merely comparatively cheap, but cheaper than anything which was manufactured in this country. It is well that people should realise this fact, and not build hopes of a boom in craftwork on a very insecure foundation. On the other hand, it would be very much to be regretted if the general desire to economise, and to spend money mainly on objects directly connected with the war, should lead to stagnation in the many branches of artistic craftsmanship in which good work is being done.

The exhibits at Maddox Street reached, many of them, quite a good level of accomplishment. Most of the crafts practised by women were represented, and such seasonable objects as hand-written and illuminated Christmas cards and calendars, or hand-coloured prints and reproductions destined for the same purpose, were good of their kind. The greatest interest of the exhibition, however, lay in the textile exhibits. Women's exhibitions are, of course, usually strongest on this side, and *The Englishwoman* Exhibition was no exception to the rule. The rugs and woven fabrics were specially worthy of notice on account of their colour, which quite often was both unusual and good. Some of the shades produced by the Cullompton Weavers were specially fine, notably the orange, whilst good work was shown by the Somerset Weavers. Mrs. Mairet of Shottery, Stratford-on-Avon, exhibited some children's dresses, etc., into which patterned weaving was successfully introduced and made use of to very good purpose. There was some very satisfactory needlework in the traditional styles and stitches of the Eastern Mediterranean shown by Lady Egerton's Cretan School; the Friends of Armenia exhibited some interesting semi-Oriental work, and the British needlework was represented by specimens sent by Miss Nowall, the Fine Needlework Association, and others. What seemed to be a new departure on really admirable lines was the collection of designs from Old English, Persian, Turkish, Italian and other sources prepared by the Alphabet Transfer Company. There are many women who have neither the time nor the skill to make their own designs, and some of them are persons of taste who do not wish to waste their energies on reproducing with much labour just the ordinary trade transfer patterns. The designs put forward by the Alphabet Transfer Company (to be obtained from Miss S. I. Welsh, Owslebury House, near Winchester) are for the most part admirable, and marked by a real distinction. The company, moreover, has had the wisdom and the forethought to provide worked models to show how the patterns may be executed with good effect. This is a way of encouraging good design and workmanship which ought not only to prove a boon to many people, but to become a really educative force. It is to be hoped that the effort will meet with that success which it undoubtedly deserves.

Decoration and Wallpapers.—The European situation has made things very dull in the trades connected with house decoration. Here and there some enterprising firm makes a little show of

energy, and textiles and wallpapers in which lions or crowns or patriotic emblems of one sort or another form an important feature are ostentatiously displayed in the windows, but on the whole there is little of interest to be seen, and, oddly enough, the change of temper produced by the war has made some of the patterns and treatments which would only a few months ago have attracted most attention seem altogether out of place. Further, as regards wallpapers, many of the necessary materials are unavailable or the supply of them is restricted. Flock, for instance, comes from France, where the makers are at present otherwise engaged and have no leisure to produce it. Some of the paper itself is made abroad, and though Holland at any rate can go on producing her share of that, even then bringing it over to this country is not quite such a simple operation as it is in more normal times. As to the colours, bronzes, etc., the paper-stainers seem to be in much the same position as the textile printers, and to be suffering, or expecting to suffer, as the result of having relied to a very large extent on Continental manufacturers. In view of all these difficulties, added to the natural fear on the part of the manufacturers that people will be in no mood for spending their money on decoration, it would not have been surprising if no new patterns had been proceeded with for next season. Such a state of affairs would have pressed rather hardly on the designers, and upon just those designers who are practical men, and whose services will be of the greatest value when it comes to the capturing of trade after the war. It is, therefore, cheering to find that the preparation of next year's patterns in block-printed papers has gone on as usual, and that in no niggardly fashion. Messrs. Jeffery & Co., whose reputation rests so largely on their block-printed work, are bringing out a whole series of designs worthy of the best English traditions. They are producing patterns by Edgar Patterson, Sydney Hayward, Heywood Sumner, and other well-known designers, and as wide a range of designs as usual will be obtainable. Some are large damask patterns or rather smaller all-over designs on traditional lines, others are in the style which some particular artist has made his own, but what might be taken perhaps as the prevailing tendency of the season is rather towards naturalistic treatment. Some of the flower designs, in which the blossoms are massed together very much as they might be seen in a herbaceous border, look as though they would make excellent backgrounds and they afford opportunity for really beautiful colouring. The panel form of dividing up the wall is, of course, provided for, and the modern demand for a wallpaper which shall look like anything rather than what it really is has left its mark on some of the fillings and backgrounds. It is obvious that people who want really the last new thing in wallpapers next season will be able to have it and to have it of the best quality. Although block-printed wallpapers wear so well that they cannot be called an extravagance, they cannot compete in the matter of price with machine-made papers. To bring them out at a time like this is a venture of faith which, in the interests of artists and workers no less than of the manufacturers, is deserving of all possible support from the public.

CORRESPONDENCE.

BRITISH TRIMMINGS AND EMBROIDERY.

In connection with the article on trimmings and embroidery which appeared in the *Journal* of November 6th, the difficulty which strikes me is that of knowing what fashion will demand next. By the time trimmings of any special sort have appeared in shops or fashion papers it is too late to make designs for that particular kind of thing. Articles having been produced, it is the object of the manufacturer to sell them, and not to let any one suggest designs or colours which might possibly overshadow his. I should be very glad if any reader of the *Journal* could suggest a way out of this difficulty.

F. EDITH GILES, Principal.

Clapton and Stamford Hill School of Art,
81, Clapton Common, N.E.
November 16th, 1914.

GENERAL NOTES.

OPENINGS FOR SOAP IN THE RED SEA MARKET.—According to the American Consul at Aden, conditions there are favourable for the introduction of American soap. If that be the case, then there should be an opportunity for the British manufacturer to increase his trade, for it appears that out of 12,547 cwt. of soap imported into Aden in the year ended April 1st, 1913, only 409 cwt. came from the United Kingdom, France contributing to the extent of 90 per cent. of the total imports. Of the total quantity imported into Aden, 8,000 cwt. were sent to Hodeidah and Jeddah, 900 cwt. to Massowah and Italian East Africa, and 1,014 cwt. to the Arabian hinterland. The success of French soap is attributed to the fact that it was the first on the market, and that a large stock has always been kept on hand by the importers. In introducing soap to this market manufacturers must bear in mind that the great mass of the population are Moslems, and eschew any composition of foreign manufacture likely to contain animal fats. Only soap made from vegetable oils should be brought to this market, and each cake of soap should be stamped accordingly. As most of the natives are illiterate they are often influenced by the trade-mark, and if satisfied with the article it is difficult to persuade them to accept another mark. A trade-mark reproducing an animal should be carefully avoided. A palm tree or a rose, for example, would appeal to a native's taste and

memory, and do much towards inducing him to the belief that no animal matter is contained in the soap.

MARKET FOR CEMENT IN THE CANARY ISLANDS.—No cement is manufactured in the Canary Islands, but the consumption is larger than is usual in communities of like population. As the rainfall is slight, and agriculture depends upon irrigation, the whole cultivated country is dotted with water tanks and lined with aqueducts of concrete. New water sources are constantly being developed, extending the arable area, and the construction of new tanks and conduits, added to the considerable building activity in the cities and towns, creates a large demand for Portland cement. For many years the United Kingdom supplied more cement than any other country, but in 1911 Belgium took first place, and has since held it by increasing margins. There are six countries competing for the Canary Islands cement market, namely, Belgium, France, Germany, Netherlands, Spain and the United Kingdom, and the various makes of cement are better advertised in the Canary Islands than any other article of local consumption, newspapers, announcements on the walls, bill boards and cinematograph films being all used to obtain publicity. In connection with the question of imports of Belgian cement into the Canary Islands, it may be mentioned that this cement is labelled entirely in English, is usually without marks indicating its origin, and, like other Portland cements, comes in barrels of 180 kilos. (approximately 400 lbs.).

MEETINGS FOR THE ENSUING WEEK.

MONDAY, NOVEMBER 23...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. R. A Peddie, "The History and Practice of the Art of Printing" (Lecture I.)

East India Association, Caxton Hall, Westminster, S.W., 4 p.m. Mr. A Yusuf Ali, "India's Rally round the Flag."

Surveyors' Institution, 12, Great George-street, S.W., 8 p.m. Mr. E. Savile, "Our Wheat Supply."

Geographical Society, Burlington-gardens, W., 8.30 p.m. Viscount Bryce, "The Mental Training of a Traveller."

Faraday Society, at the Chemical Society, Burlington House, W., 8 p.m. 1. Introductory address by the President, Sir R. Hadfield, on "The Hardening of Metals." 2. Dr. G. T. Beilby, "Some Recent Papers on Hardening and Overstrain in Metals, and the bearing on these of the author's Amorphous Theory of the Hardened State." 3. Professor E. Cohen, "The Influence of Allotropy on the Metastability of Metals and its bearing on Chemistry, Physics, and Technics." 4. Paper by Professor H. C. H. Carpenter. 5. Paper by Professor J. O. Arnold. 6 Professor C. A. Edwards, "The Hardening of Metals by Quenching." 7. Paper by Dr. W. Rosenhain. 8. Mr. A. McCance, "The Interstrain Theory of Hardening." 9. Mr. J. C. W. Humfrey, "The Part Played by the Amorphous Phase in the Hardening of Steels." 10. Dr. C. H. Desch, (a) "The Hardness of Solid Solutions"; (b) "A Note on Twinnings and the Martensitic Structure." 11. Dr. T. M. Lowry and Mr. R. G. Parker, Note on "Metallic Filings." 12. Professor H. M. Howe and Mr. A. G. Levy, "The Hardening of Manganese Steel." 13. Mr. H. L. Heathcote will Demonstrate instruments for Testing Hardness.

Medicine, Royal Society of, 1, Wimpole-street, W. Section of Odontology, 8 p.m. 1. Presidential Inaugural Address. 2. Dr. H. L. Lack, "The Influence of Nasal Obstruction on Abnormalities of the Jaws."

TUESDAY, NOVEMBER 24...Photographic Society, 35, Russell-square, W.C., 8 p.m. Lantern Lecture.

Zoological Society, Regent's-park, N.W., 8.30 p.m. 1. Messrs. E. Heron-Allen and Arthur Earland, "Exhibition of Tests of Arenaceous Foraminifera to introduce a Discussion on the Interpretation of these Structures." 2. Mr. D. M. S. Watson, (a) "A New Fossil Reptile from South Africa"; (b) "Notes on some Carnivorous Therapsids"; (c) "*Eunotosaurus africanus* Seeley, and the Ancestry of the Chelonia." 3. Mr. F. A. Potts, "Polychæta from the N.E. Pacific: the Chætopteridæ. With an Account of the Phenomenon of Asexual Reproduction in *Phyllochætopterus* and the Description of Two New Species of Chætopteridæ from the Atlantic."

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 4 p.m. Mr. H. A. Ellis, "The Expansion of Britain's Imperial Relations with the Oversea Dominions resulting from the War."

WEDNESDAY, NOVEMBER 25...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Sir W. A. Tilden, "The Supply of Chemicals to Great Britain and her Dependencies."

Literature, Royal Society of, 20, Hanover-square, W., 8.30 p.m. His Excellency Senhor Manoel Oliveira Lima, "The Influence of European Thought on Brazilian Literature."

THURSDAY, NOVEMBER 26...Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Camera Club, 17, John-street, Adelphi, W.C., 8 30 p.m. Mr. A. E. Johnstone, "Greek Days and Greek Ways."

Electrical Engineers, Institution of, Victoria-embankment, W C., 8 p.m. Mr. W. M. Selvey, "Power-plant Testing"

FRIDAY, NOVEMBER 27...Literature, Royal Society of, 20, Hanover square, W., 5 p.m. Meeting of the Academic Committee. The following Addresses of Reception will be delivered :—To Mrs. A. Meynell, by Mr. H. Newbolt; to Mr. G. L. Dickinson, by Mr. A. C. Benson. Mr. J. Masefield will make the fourth award of the Edmond de Polignac Prize.

Engineers, Junior Institution of, 39, Victoria-street, S.W., 8 p m. Mr. C. E. Ford, "A Model Drawing Office System."

Physical Society, Imperial College of Science, South Kensington, S.W., 5 p.m.

Medicine, Royal Society of, 1, Wimpole-street, W. Section of Epidemiology and State Medicine, 8.30 p.m. 1. Dr. W. G. Armstrong, "The Recent Epidemic of Smallpox in New South Wales: Its Diagnosis and Prevention." 2. Drs. J. B. Cleland and E. W. Ferguson, "The Nature of the Recent Smallpox Epidemic in Australia."

SATURDAY, NOVEMBER 28 ... Chadwick Public Lectures, Bedford College, Regent's-park, N.W., 3 p.m. Dr. A. T. Nankivell, "Camp, Ship and Hospital Hygiene." (Lecture III.)

Municipal Engineers, Institution of, 4, Southampton-row, W.C., 11.45 a.m. Annual General Meeting. 2.45 p.m. 1. Presidential Address, by Mr. H. Boot. 2. Mr. G. B. Chilvers, "A Plea for the Better Remuneration of Municipal Surveyors and Inspectors of Nuisances in small Urban and Rural Districts." 3. Mr. E. Whitwell, "Housing of the Working Classes." 4. Mr. J. S. Wooddisse, "The Future Control and Maintenance of Rural Roads."

Journal of the Royal Society of Arts.

No. 3,236. VOL. LXIII.

FRIDAY, NOVEMBER 27, 1914.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK

MONDAY, NOVEMBER 30th, at 8 p.m. (Cantor Lecture.) R. A. PEDDIE, Librarian, St. Bride Foundation Typographical Library, "The History and Practice of the Art of Printing." (Lecture II.)

WEDNESDAY, DECEMBER 2nd, at 8 p.m. (Ordinary Meeting.) WILLIAM REGINALD ORMANDY, D.Sc., F.C.S., "Britain and Germany in Relation to the Chemical Trade." The RIGHT HON. LORD MOULTON, LL.D., F.R.S., will preside.

Further particulars of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, November 23rd, MR. R. A. PEDDIE delivered the first lecture of his course on "The History and Practice of the Art of Printing."

The lectures will be published in the *Journal* during the Christmas recess.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Tuesday afternoon, the 24th inst. Present:—

Sir Steyning William Edgerley, K.C.V.O., C.I.E. (Chairman of the Committee), Sir Arundel T. Arundel, K.C.S.I., Sir Steuart Colvin Bayley, G.C.S.I., C.I.E., Thomas Jewell Bennett, C.I.E., Sir M. M. Bhownaggree, K.C.I.E., William Coldstream, B.A., I.C.S. (retired), Laurence Currie, M.A., J.P., Right Hon. Sir Henry Mortimer Durand, G.C.M.G., K.C.S.I., K.C.I.E., James Fairbairn Finlay, C.S.I., I.C.S. (retired), R. A. Leslie Moore, I.C.S. (retired), Colonel Charles Edward Yate, C.S.I., C.M.G., M.P., with Sir Henry Trueman Wood, M.A. (Secretary of the Society), and S. Digby, C.I.E. (Secretary of the Section).

JUVENILE LECTURES.

The usual short course of lectures adapted to a juvenile audience will be delivered on Wednesday afternoons, January 6th and 13th, 1915, at 5 p.m., by MR. H. PLUNKET GREENE, who gave a course of Cobb Lectures on "The Singing of Songs, Old and New" last session.

Special tickets are required for these lectures. They can be obtained on application to the Secretary.

A sufficient number of tickets to fill the room will be issued to Fellows in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions, each Fellow is entitled to a ticket admitting two children and one adult. Fellows who desire tickets are requested to apply for them at once.

PROCEEDINGS OF THE SOCIETY.

SECOND ORDINARY MEETING.

Wednesday, November 25th, 1914; SIR WILLIAM RAMSAY, K.C.B., LL.D., Sc.D., F.R.S., F.I.C., in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Bates, Onward, 332, South Michigan Avenue, Chicago, Illinois, U.S.A.

Bone, Philip James, New Bedford-road, Luton, Bedfordshire.

Fearnley, Ths., Messrs. Fearnley & Eger, Post Box 223, Christiania, Norway.

Otis, Herbert Foster, The Laboratory, Nahant, Massachusetts, U.S.A.

The paper read was—

THE SUPPLY OF CHEMICALS TO BRITAIN AND HER DEPENDENCIES.

By Sir William A. Tilden, D.Sc., LL.D., F.R.S.

To those who can look back over half a century, the progress of scientific and industrial chemistry, and the relations of the one to the other, present many features of extreme interest. After the days of Lavoisier, and during the earlier part of the nineteenth century, the foundations of theoretical chemistry were laid by the efforts, contemporaneous but independent, of the chemists of England, France, and Sweden. The great names associated with the movement include Davy, Faraday, Dalton, Gay-Lussac, Dumas, and Berzelius. There were no German chemists of the first rank in those days, and if we look among them for fundamental discoveries we can only find one of considerable importance, namely, the discovery of isomorphism by Eilhard Mitscherlich in 1819. But the birth of Justus Liebig at Darmstadt, in 1803, gave to German science a leader whose influence stretches down to our own day, and is felt wherever chemistry is studied or practised. The department of organic chemistry has been the field in which the most remarkable successes have been won, though not wholly, as sometimes represented, by the German chemist.

The relation of optical activity to atomic constitution was the discovery of Le Bel, a Frenchman, almost simultaneously with Van 't Hoff, a Dutchman, and the application of their theories to the phenomena presented by compounds other than those of carbon, was illustrated in the first instance by Smiles, and by Pope and Peachey, all of whom are Englishmen. It will also be only fair to state that while we readily acknowledge with admiration the brilliant work of Von Baeyer and Emil Fischer in connection with the synthesis of indigo, the sugars and the proteins, the fundamental principles which underly all chemical theory, have been established almost entirely by the chemists of other nations. It is only necessary to recall such subjects as the atomic theory, the periodic law, Faraday's laws of electrolysis, the theory of free ions, the phenomena of radioactivity, and the discovery of radium, to show that in laying down broad general principles German chemists have not usually been the first in the field, though at later stages they have shown great and commendable activity.

Turning now to the position of industrial chemistry, a single brief quotation from the "Report on Chemical and Pharmaceutical Products and Processes" in the International Exhibition of 1862, from the pen of A. W. Hofmann, then Professor of Chemistry in the Royal College of Chemistry and Royal School of Mines, London, will be sufficient. He says (p. 3): "The contributions of the United Kingdom, and in particular the splendid chemical display in the Eastern Annexe, prove the British not only to have maintained their pre-eminence among the chemical manufacturers of the world, but to have outdone their own admitted superiority on the corresponding occasion of 1851."

On referring to the table of statistics which appears on the same page of the report, we find that of the 762 exhibitors in the class, the United Kingdom was represented by 200, while Germany, Austria, the Zollverein and the Hanse towns together mustered only 136. France stood next with 115 exhibitors. It will be remembered that at the date of the exhibition, the discovery of the so-called aniline colours was bearing very important industrial fruit. Mauve, or aniline purple, was discovered by W. H. Perkin in 1856, and aniline red was first obtained industrially by Verguin and Renard frères of Lyons a few years later.

It is also interesting to notice that among the early investigators and patentees of processes connected with the production of colour from coal-tar hydrocarbons, only English and French names are to be found, with the significant exceptions of Hofmann and Caro, both of whom were at that period resident in England. At this time synthetical chemistry in the modern sense was as yet unpractised because unknown. Such an important substance as salicylic acid, for example, was a mere laboratory product, obtainable only from natural sources.

But the activity of the chemical industries in the United Kingdom is not to be measured only by reference to subjects such as those of the coal-tar colours, nor by the number of exhibitors in an international exhibition even at that early period in the history of exhibitions, at which manufacturers were far more eager to find a place than they have been in more recent times. Statistics in relation to the development of the alkali trade show how rapidly the production of what are called "heavy chemicals" was proceeding at this period. Figures derived from returns collected by Mr. Christian Allhusen from 81 per cent. of the manufacturers in the United Kingdom,

immediately after the first Great Exhibition, are shown below. These may be compared with statistics prepared by Mr. W. Gossage for the year 1861 immediately before the Exhibition of 1862 * :—

	1852.	1861.
	Tons.	Tons.
Soda Ash.	71,193	156,000
Soda Crystals . . .	61,044	104,000
Bicarbonate	5,762	13,000
Bleaching Powder .	13,100	20,000

The value of these products for 1852 was estimated at about 1¼ million pounds, while the value of the products of 1861 was calculated by Mr. Gossage at upwards of two millions sterling.

The Board of Trade has recently issued a Bulletin concerning German competition in the United Kingdom market, and on page 2 we find the statement that the soda compounds, excluding chromates and bleaching powder, produced in the United Kingdom in the year 1907, are valued at £3,390,000. The imports from Germany in 1912 are valued at only £8,700. As to bleaching materials, the product of the United Kingdom for 1907 is estimated at £527,000, while the import from Germany for 1912 was £44,600.

From these figures the easy deduction is made that " the imports of these chemicals into the United Kingdom from Germany are relatively insignificant when compared with the output of the same articles in this country. It is clear that in these particular lines British manufacturers have no need to fear German competition in the home market."

Similar remarks apply to aluminous compounds, coal-tar products not dyes, the cyanides, sulphuric acid, and other acids for which the Bulletin may be consulted. It thus appears that the British manufacturers of sulphuric acid and soda, from the early times of a century ago, have been able, up to the present, to hold their own against foreign competition, and have thus added substantially to the revenues and well-being of their country.

The immense advances in every direction made in all civilised countries have brought demands in steadily increasing quantities for a variety of materials of which many were unknown to the generations immediately preceding our own. These are almost all the outcome of the progress in our own time of chemical knowledge. Since the introduction of the coal-tar dyes the development of chemical theory has rendered possible the production in the laboratory of a large number of organic substances which are either identical with compounds already known as occurring in Nature, or from their ascertained physiological action have added incalculably to the resources of the physician and surgeon in relieving pain and in curing disease. These include not only drugs for internal administration, but antiseptics, the use of which was only beginning to be recognised at the time of the Exhibition in 1862. (Hofmann's Report, pp. 104–105.)

To these must be added essential oils and other volatile aromatic substances, the application of which to perfumery and flavouring has undergone a stupendous development during the last thirty years.

The innumerable applications of photography have also led to a demand for developing, fixing, and toning materials, as well as for plates and films on a very large scale.

The arts of peace as well as the operations of war have also led to the production of explosives of many new types formerly unknown.

There is also another department of business which requires notice, and that is the demand for pure chemical reagents for analysis and research which has increased to an extent very difficult to calculate, but is manifestly very large. The modern university and technical colleges, nearly the whole of which have come into existence within the last forty years, the large body of Public Analysts appointed under the Sale of Food and Drugs Act, 1875, the establishment in nearly all the public schools and high schools of laboratories for teaching chemistry, as well as the numerous technical laboratories connected with such institutions as the Government Laboratory, the National Physical Laboratory, the Metropolitan Water Board, and many others, afford sufficient evidence that there are several hundreds of chemical laboratories distributed over the United Kingdom in which pure chemicals are required for analytical purposes.

Now leaving to the department of " heavy chemicals " all such things as agricultural and horticultural washes, coarse disinfectants and artificial manures, the question arises, How do we in England stand in regard to the supply of drugs, dyes, photographic chemicals, and

* Gossage's " History of the Soda Manufacture."

perfumes at a time when many of these things are very urgently needed?

It may be safely asserted that the sources of supply of all these materials in the United Kingdom are seriously inadequate. And, further, we may point to the acknowledged fact that many of the dyes, nearly all the synthetic drugs and photographic materials have been systematically imported from Germany.

The Annual Statement of the Board of Trade (p. 108) shows that in 1913 we imported from Germany:—

	£
Alizarin and Anthracene Dyes . .	271,119
Aniline and Naphthalene Dyes. .	1,382,478
Synthetic Indigo	76,681
	£1,730,278

Under the head of "Drugs, unenumerated, including Medicinal Preparations" (p. 107), out of a total of imports from foreign countries and from British Possessions amounting to £1,302,860, more than one-fourth, or to the value of £332,464, was in 1913 received from Germany. From this is to be deducted the inconsiderable amount of dyes and other chemicals from coal-tar, valued at £24,691, exported in 1913 to Germany (p. 300). According to the Final Report on the First Census of Production of the United Kingdom for 1907 (p. 547), this country made 139,000 cwt. of coal-tar dyes, valued at £373,000, of which practically the whole was consumed at home.

As to fine chemicals for analysis and for research, there are no figures available, but it may safely be said that there has been no appreciable production of these things in this country. If such a statement is met by protests from manufacturers who profess to supply these materials it is only necessary to refer to the experience of analysts and directors of research laboratories, which has compelled many of them to resort habitually to German makers for their supplies of trustworthy reagents.

If we are ever to be in a position to supply ourselves and our Dependencies with the dyes, the drugs and the rest of the fine chemicals required in our work, it will only be achieved after a careful review of the circumstances which led to the removal of the industries from this the country in which many of them originated, together with a determination to take to heart the lessons of the past.

A chemical manufacturer, discussing the neglect of fine chemicals in this country, recently made the remark: "What does it matter if we are making money?" I venture to say that that view expresses neither patriotism nor common sense. For the same principles which have served as the basis of the German success in relation to dyes and fine chemicals apply equally to the production of heavy chemicals, and already German chemists have been boasting that, having secured the trade in the former, they are about to attack the latter.

The export trade in sulphuric acid alone is already three times as great from Germany (1912) as from the United Kingdom (1913), as shown by the figures given in the recent Bulletin issued by the Board of Trade. (Commercial Intelligence Branch, October, 1914.)

The recent success of Professor Haber, of Karlsruhe, in the synthetical production of ammonia from hydrogen and atmospheric nitrogen, a process which has been put into operation on an industrial scale by the Badische Company, ought surely to carry something significant to the unprejudiced mind. Neither is it superfluous to point to the extensions taking place in several countries of operations in which the nitrogen of the atmosphere is being fixed in the form of cyanamide, of nitrites and nitrates in which the industrial lead has been taken by Germany, which also supplies a large proportion of the capital, though at present not to the exclusion of the British.

The extent to which the German chemist arrogates to himself the whole field of scientific and industrial chemistry, is illustrated in the report (given in full in *Nature*, 85, p. 558) of a lecture given by Professor Emil Fischer on January 11th, 1911, in the presence of the Emperor, on the occasion of the inauguration of the Kaiser Wilhelm Gesellschaft zur Förderung der Wissenschaften. It is at least unpleasant to hear of a man so eminent as Professor Fischer, and so worthy of respect, treating the subjects of his discourse as though every one of them had originated and been developed in Germany. Perkin is indeed referred to as the discoverer of mauve, but every other foreign name is omitted.

If I now try to recall some of the circumstances which led to the gradual transference of the colour industry from this country to Germany, and the failure to establish here any appreciable production of the synthetic drugs and other chemicals now so urgently needed, it will not be the first time the facts have been stated and the obvious conclusions deduced therefrom.

All the substances referred to belong to the department of organic chemistry, and it might

perhaps be supposed that neglect of this branch of the science by the chemists of this country was the cause of the loss of business. When Hofmann was unfortunately allowed to leave the College of Chemistry to return to his own country, a check was for some time observable in the output of research among us, but it must be remembered that the number of institutons in all countries in which the study of chemistry was pursued was then relatively small. Even in Germany the Chemical Society in Berlin did not come into existence till 1867, and up to that time there had been no laboratory for practical instruction in chemistry in the university of that city.

For the last thirty years, however, the progress of research in this country has gone forward at an increasing rate, though still less rapidly than in Germany. The slow development of chemical teaching and research in this country was attributed by many people to the anti-scientific influences at work in our universities, and especially the older universities. This point of view was exposed very clearly and forcibly by the late Sir William Perkin in presidential addresses delivered to the Chemical Society and the Society of Chemical Industry in 1885. And up to this time it would be indeed difficult to exonerate Oxford and Cambridge from responsibility in the evil example shown by those great seats of learning. But since that day many changes have taken place, and great advances have been made. What is wanted in the British universities is, first of all, that no man shall in future be appointed to a professorship, or indeed to any teaching post in connection with physical or natural science, who does not show his ability to instruct in the higher branches of his subject by the character of the researches which he continues to carry out during his tenure of office; and, secondly, such a change in the curriculum and endowments that there may be not only a supply of instruments and materials but a sufficient body of trained assistants in the form of advanced students to enable the professor to pursue without delay any promising line of investigation.

Notwithstanding the difficulties which stand in the way the scientific chemists of this country are, however, not idle. Evidence of this may be seen in the *Transactions* of the Chemical Society, the volume of which for 1913 contains 238 papers extending over more than 2,300 pages. And when it is remembered that these papers have survived the severe censorship exercised by the Publication Committee of the Society the result must be considered encouraging. It appears, then, that it is not to the scientific part of the chemical world that blame attaches in recent times.

Forty years ago it would be safe to say that there were practically no chemists engaged in the direction of the chemical works of this country, and by chemists I mean fully qualified scientific men. Probably in the palmy days of colour-making it would have been difficult to meet with a British manufacturer who had ever heard of Kekulé's benzene theory, or would have thought it worthy of a moment's notice by a practical man. And yet at the Kekulé jubilee in 1890 a representative of the German coal-tar colour industry declared that the prosperity of Germany in this direction was primarily due to this theoretical conception. Even in much later times the chemical manufacturer in this country has repeatedly had facts laid before him which ought to have attracted his serious attention. One of the most convincing statements was laid before this Society by Professor Meldola on May 13th, 1886, and one would suppose that the figures then given would have been sufficient to create well-founded alarm. For he showed, on the testimony of a considerable number of prominent English dyers, that already about nine-tenths of the colours employed by them were imported from Germany. Again, in a lecture given before the British Association in 1901, on the "Relative Progress of the Coal Tar Industry in England and Germany during the past fifteen years,"* Professor Green showed clearly the steady increase in the imports of dyestuffs from Germany into England, and the steady decline in the production of similar materials in England.

Finally, we have the fact known to all the world that one of the most notable triumphs of German chemical industry is the production of synthetic indigo made from naphthalene on a scale so large as to have almost driven the Indian planter from the field. In this case we have over again a story nearly corresponding to the history of the introduction of artificial alizarin in 1869, an event which was speedily followed by the abandonment of the cultivation of madder in the south of France and elsewhere. And to-day we learn from the Board of Trade statement for 1913 that we imported indigo from Germany to the value of £76,681, while the value of the natural indigo from India has

* Printed in full in the *Journal* of the Society of Dyers and Colorists for December, 1901.

declined from £124,112, in 1909, to £48,208 in 1913. As to the cause of this serious reduction of chemical business authorities are unanimous.

Perkin in the address to the Chemical Society already quoted, attributed the success of the German industries to the employment of high-class chemists. (*Trans. Chem. Soc.* 45 [1884]. p. 219 *et seq.*)

The same view was expressed by Professor Meldola in his paper before this Society in 1886. "The strength of our competitors," he says, "is in their laboratories and not, as here, on the exchanges."

Professor Green stated as his opinion, in the lecture referred to, that the remedy for the present state of affairs can only be found in a better appreciation of the value of science throughout the length and breadth of the land, and that it is not so much the education of our chemists which is at fault as the scientific education of the public as a whole. Nor can much improvement be expected till the public, including manufacturers, can be disabused of the fallacy that a year or two of technical training pumped into an ignorant schoolboy will produce a better works chemist than a university course of scientific study laid upon the foundation of a good general education.

If these are supposed to be merely the prejudiced opinions of British chemists, the sentiments expressed by German manufacturers themselves may be appealed to.

In 1900 a lecture was delivered on the occasion of the opening of the Hofmann House in Berlin by Dr. H. Brunck, since 1884 chief technical Director of the Badische Company, on the "History of the Development of the Manufacture of Indigo." This lecture, in the form of the English version issued by Dr. Brunck, may be fairly regarded as a sermon preached to British manufacturers. Its perusal will convince anyone that the success which has been achieved is the reward of long-sustained investigation in the laboratory of the scientific chemist, and to do justice to this conviction I wish every chemical employer in this country could be induced to read the weighty and eloquent words of the author. He would then perceive that to permanent industrial success there is only one road, and that the way pointed by science.

I will content myself with quoting only a passage or two from Brunck's lecture (pp. 4, 22). "With grateful admiration and reverence do we recall those ever memorable masters, Kekulé and A. W. von Hofmann, whose gifted achievements have laid the foundations of our industry. And when we look back at all the technical achievements we also gratefully recall the fertile discoveries of Graebe and Liebermann, of Peter Griess, and the beautiful researches of Emil and Otto Fischer, of O. N. Witt and the numerous other investigations conducted in our university laboratories, which have acted as incentives for chemical industry, and have furnished the foundation for renewed progress. But first and foremost we are impressed by the mighty influence of the investigations of A. von Baeyer, to whom the coal-tar colour industry is indebted for a great number of important achievements, and who himself has, to-day, unfurled before you the picture of a magnificent scientific creation, from which it was possible for chemical industry to construct and develop one of its grandest achievements.

"But this infant industry was no longer content to be dependent on the gifts which were made to it from various scientific sources. Renowned investigators placed themselves entirely at the disposal of chemical industry; young men in great numbers devoted themselves to it, and grew up with it in enthusiastic and self-directed activity. Such men as Caro, Glaser, Martius, and later on Laubenheimer, Duisberg, Bernthsen, and many others, introduced the spirit of scientific investigation into industrial practice." And, in conclusion, he says: "You have seen that this new industry is not an unexpected gift fallen from the heavens, but that in order to complete the task the intellectual labour and the industry of many men had to be co-ordinated in an organised attempt to attain a definite object for a number of years and throughout a considerable period when success could by no means be regarded as certain. The pre-requisites for practical indigo synthesis were supplied by the results of long years of scientific labour."

In the semi-annual report for April, 1903, issued by Schimmel & Co., the famous manufacturers of essential oils, there are some figures which show the increase of chemical works in Germany and the great increase in the numbers of qualified workmen employed therein, on which the firm makes the following remark:—"The foregoing figures show clearly that the German chemical industry has passed intact through the economic crisis of the last few years. Further, there are no grounds for fearing that it will be outstripped by competition from abroad, so long as the German universities possess such eminent representatives of chemical science."

It is now time to consider what ought to be

done and what it is possible to do in this country to remove reproach from British chemical industry, and to render the Empire independent of supplies from foreign sources.

We need many first-rate chemists, a few engineers, plenty of capital, and some good men of business. A combination of these elements in due proportion is certain of success, and the time, though so unhappy for the world, is favourable for this enterprise.

Inasmuch as the functions of each and the best way of combining them have already been settled in practice on the Continent, it is to be hoped that the ancient precept about being taught by the enemy—*fas est et ab hoste doceri*—will not be forgotten. For there can be no doubt that the principle acted on in all German chemical factories, namely, the employment of the best available scientific skill and the constant appeal to scientific research, has been the secret of their success.

In the British colleges and universities there are many able young chemists, but many more are required. Here education and industry interact on each other. If the demand for scientific assistance were more general, the supply of well-qualified men would soon be greatly increased, and greater attention given by the teachers to the industrial side of the subject. At present other professions in which the prospects are more alluring attract into other lines of work much of the talent of the country. This, however, is not to be interpreted as meaning that there is not now a supply of able young chemists sufficient for immediate needs. The difficulty is to induce chemical manufacturers to treat them reasonably. The pay offered is generally insufficient, and though conditions are somewhat improved of late years, the employer too often expects immediate profitable returns from the engagement of a scientific man. In the Badische works at Ludwigshafen the plan has been to engage university men on the recommendation of their professors for a term of years, at a salary which will enable the new members of the staff to live at least modestly. I am told that in some American works the same system has been adopted. These young men are placed in the research laboratory under the chief chemist controlling the department of manufacture selected, and it is not expected that they will accomplish anything very remunerative at first. But their future depends on their ability and activity, and they act accordingly.

Then there is the position to be accorded to the engineer. He is, of course, indispensable; but the part he should play in the works depends on the nature of the processes involved. So far as relates to buildings and other structures, to supplies of water, fuel, power and electricity, the engineer has the field to himself, but the operations in which materials are to be employed in producing and controlling chemical reactions which lead to the desired product belong to the chemist, and here he ought to be supreme. In some of the old-established operations an engineer with an elementary knowledge of chemistry may carry on for a time, but in these days a chemist with the most extensive and intimate knowledge of physical chemistry is necessary if these processes are to continue to be profitable. As to the production of dyes and other organic synthetical products the operations involved are in many cases so nearly similar to laboratory processes that the chemist requires very little assistance from the engineer.

As to capital, it is necessary to remember that it will have to be provided liberally. A single fact mentioned in Brunck's lecture on indigo, given already fourteen years ago, shows the spirit in which the German manufacturers attacked the problem of the industrial production of this one colouring matter. They had then invested about £900,000 for this purpose.

I will now describe very briefly a modern chemical works. The lantern pictures exhibited show a general view of the works of Schimmel & Co., at Miltitz near Leipzig, first occupied in 1901. The works cover about sixty-two acres. The head office is built over cellars of nearly 22,000 square feet, used as a store for the products of manufacture which, in this case, consist of essential oils and perfumes. The offices are provided with every kind of modern convenience, together with a printing department furnished with electrically-driven machinery. The main building (24,000 square feet) is occupied by stills and other machinery, and in addition there are several laboratories for special manufacturing operations. A feature to which special attention should be drawn is the research laboratory, a separate edifice providing accommodation originally for fifteen chemists, though since enlarged, and containing a library of several thousand volumes, and a museum. The rest of the area occupied by the firm affords space for a number of villas for the resident portion of the staff, and cottages for workpeople. The whole is surrounded by extensive fields in which roses are cultivated.

The works of the Badische Anilin u. Soda

Fabrik, at Ludwigshafen, are arranged on a different plan, because their products are so diversified; but the same principle is recognised, namely, the inseparability of research and manufacture. A number of rectangular buildings, four stories high, are so arranged that the railway lines may traverse the works in two directions at right angles to each other. Each building is devoted to the production of one substance or closely allied group of substances. The top floor is occupied by the laboratory of the chief chemist attached to that department, with several assistants. Below is found an intermediate floor where processes previously tested in the laboratory, or suggested as the result of research, may be tried on a scale sufficiently large to determine their practicability before being transferred to the lower floors where the actual manufacture is conducted. I doubt if anything so complete or so commercially successful exists elsewhere in the world.

How many chemical manufacturers among us can boast that they regard science in a light so serious as to have provided in their works a properly equipped laboratory with a competent staff whose occupation is not confined to the analytical testing of materials or products, but extends to the systematic endeavour to introduce improvements into old methods or the discovery of new ones? A few such enlightened firms do exist, but the figures quoted show how much mischief has already been done.

A variety of other questions have recently been raised in view of the circumstances which have been forced on our notice by the war. There is not time for the discussion of the state of the law as to patents, but a couple of sentences in Schimmel's report for April 1908, show that "great alarm has been caused in the wholesale chemical industry of Germany by the new British Patent Act, which came into force on January 1st, 1908, according to which every patent may be declared void if it is exclusively exercised abroad without sufficient grounds. Many firms are thereby compelled to transfer a part of their production to the United Kingdom, a fact which, in the interests of many thousands of German workmen, is sincerely to be regretted."

With regard to duty-free alcohol, I am informed, on the best authority, that the regulations in this country are now comparable with those of the German Government, and that there is very little ground for complaint. In the vast majority of cases suitably denatured alcohol can be employed without loss or inconvenience.

There has been a good deal of discussion on the subject of trade-marks and proprietary names, much of which I regard as futile. With regard to drugs there should be no great difficulty in instructing the medical profession in those comparatively few cases in which the names are changed.

In conclusion, two remarks only require to be made. The establishment of what will be practically a new industry in this country will require consideration and assistance from the State, if it is to survive the period of fierce competition which will follow the conclusion of the war. Encouragement is already promised to the dye industry, in the form of definite financial aid to be given by Government. But remembering that the colour-maker is dependent on the production of many chemicals, which represent intermediate stages in the processes which lead from the raw materials to the finished product, and that the production of these chemicals is naturally associated with other chemical manufactures, it is to be hoped that the temporary protection will be extended beyond the immediate field of the colour-maker.

The other remark may raise a smile on the part of those business men who are moved only by commercial considerations. There will be a great temptation when the war is over to resume former business relations with the enemy. The German chemical manufacturers have a powerful organisation and many years of experience behind them. Let them keep any markets they can retain outside the British Empire, but every man who cares for his country will surely demand that business at home shall be limited to British goods.

DISCUSSION.

THE CHAIRMAN (Sir William Ramsay, K.C.B., LL.D., Sc.D., F.R.S.), in opening the discussion, said the paper emphasised what we had been told so often during past years, that too little attention had been paid to the scientific side of chemical manufacture in Great Britain. But there were two aspects of the question which had not, he thought, been sufficiently touched on. The present was the time for plain speaking; what was required was a policy; and it was for the scientific and technical chemists of the country to outline the steps which were necessary in order that they might recover their former supremacy. The first aspect was as follows: Trade was regarded in Germany as a war; all means of conquest were looked on as permissible. At the annual meeting of the Society of Chemical Industry in 1903, he had said: "It was the Prussians who first showed how a

modern army should be organised . . . they have at Berlin a council which arranges each particular of each possible campaign; the men are known who will take the command, and from rank to rank the knowledge is spread as to what particular part each officer and each man will have to play in the campaign. The matter is not left to chance . . . An exactly similar policy is being pursued by Germany in the matter of industry. It would be curious if it had not occurred to the persons who are responsible for the military organisation of Prussia that a similar policy is applicable to commerce. It would be remarkable if, having succeeded so well in their military organisation, no attempt had been made to establish a similar commercial organisation; and we shall not go wrong if we assume that there is a council whose proceedings are kept quiet but which takes into consideration the statistics obtainable, and as far as possible legislates, or endeavours to legislate, on the basis of these statistics. Where fiscal duties are found to be wanted, such a council puts them on; where there is an advantage in taking them off, they take them off. Where cheap transit is possible, they let it be given; for the railways are the property of the State. Is it to be expected that any country can fight such a combination as that without adopting, at all events, something of their methods, or without studying their methods, and without combining together, if not to imitate them, at all events to thwart them? . . . There is a military campaign against us, and we must defend ourselves." Many knew that we should be at war with Germany; he personally thought that it would not happen until 1915. It had come earlier, however, and we had been taken unprepared. We now knew the methods of German warfare; and they did not appeal to us, and still less to the unfortunate Belgians. But he hoped we had learned something; that is, that in trade, as in war, the Germans were untrustworthy, unscrupulous, and cruel. He had put the second aspect of the case in a leader in *Nature*, on November 12th. He would quote it. Dealing with the organisation of a German chemical business, he pointed out: "First, the management consists, not in a board of well-meaning elderly gentlemen with a works-manager in their employment, but in a board of specialists, whose business in life is to manage the factory financially, chemically, and as engineers, and who are very highly paid for their services. Second, these gentlemen and a special staff are continuously on the look-out for any scientific discovery or invention which can prove of advantage to their business. Third, a very large staff of men, trained in universities or technical schools, is turned on to the problem of making such a discovery commercial, whether by securing cheap raw material, cheapening the process of manufacture, or creating a public demand for the article to be manufactured. Fourth, a legal staff is maintained, whose business it is to protect by patent all improvements, however apparently trivial, and to describe them so vaguely as to conceal them from their competitors; these gentlemen, in some cases, have also to advise whether piracy is likely to be successful: whether it may not be possible, by infringing a patent, so to saddle an opponent with legal expenses as to break his competition. Fifth, such companies are so powerful that they can influence the central Government to protect all new developments, whether by imposing duties on articles which might possibly compete, by extending bounties to exported products, or by securing advantages in freights to the coast, and in shipping the goods abroad. Sixth, agencies are maintained all over the world whereby the article is introduced to the notice of foreign purchasers; and last, an extensive credit system is encouraged." German competition was thoroughly organised and systematic; their plan had been to attack some material manufactured here, and, by one of the means alluded to, to render its manufacture unprofitable. Having obtained a monopoly, prices were raised. That was a not unusual method of commercial warfare; but it was only in Germany that all the resources of the State were combined to render it easy. How were such tactics to be met? That was, he conceived, the object for the present meeting. First of all, there must be co-operation and trust among our chemical manufacturers. They had to be taught to fight, not each for his own hand, but against a common enemy. Smaller works, which had not funds to maintain an expensive research staff, must combine to obtain efficient laboratories. The products of one works must supplement those of another, and the manufacturers must be organised. Second, competition which was unfavourable, owing to fiscal regulations or patent laws, must be combated by the action of the State, after advice and careful consideration, so that our manufactures and trade might not be unfairly attacked by duties, by export bounties, or by easy freights. He was well aware that he was dangerously near a much-debated political question; but his excuse was that we were now fighting for our life, and as had happened during the present crisis, politics must go to the wall under the pressure of events. All parties in the State must and would work together for the common good. Unless that was our spirit, ruin would inevitably and deservedly overtake us. In conclusion, he would like to remark that such opinions were not entirely his own. That morning he had received from M. Guillaume, Director of the Bureau des Poids et Mesures, at Sèvres, a letter in which the following remarks occurred: "I have seen since the commencement of the war the expression of your opinion of Germany. Like you, I had formerly for Germany a very great admiration, and a real sympathy; but for some years I have recognised from numerous signs that, with rare exceptions, every German possesses the soul of a highwayman and that very few are troubled by scruples. Each one wishes, at the expense of foreign nations, to satisfy gross appetites; and the choice of

means in almost every case is pretty indifferent. I have recognised this tendency in the industry with which I had something to do in past years, but it is equally visible in science, where the principle of annexation flourishes. One thing also struck me in the German tendencies, namely, an inconceivable unconscientiousness. To grab the goods of others appears to them so natural that they do not understand why anyone should wish to resist them. The whole world appears constituted for their own field of exploitation, and anyone who opposes himself to the accomplishment of this destiny is the object, to every German, of surprise. Truly, besides these Germans, and in consequence of an organisation which, all said, we are obliged to admire, life has become very difficult and pretty problematical." It had generally become recognised that the Germans had become a dishonest race, and they must be treated as such.

Professor James J. Dobbie, LL.D., D.Sc., F.R.S., remarked that the author had traced the causes of the unsatisfactory condition in which some branches of chemical industries in this country found themselves at the present time, and he had also indicated where he considered the remedy lay—that there must be more trained chemists, more capital, and a willingness on the part of the chemical manufacturer to employ his capital and to employ trained chemists in his works. He (the speaker) thought it might confidently be said, with regard to the supply of trained chemists, that at present this country was in a better position than ever it had been before. He would like to mention one fact in this connection, namely, that in the smallest of the Scottish universities, owing in the first place to the munificence of a former professor, and more recently owing to the operation of the Carnegie benefaction, a research laboratory had been founded and endowed, which was now well able to hold its own with any laboratory in this country, and with many of the German laboratories. At present there were no less than twelve students there, all of whom were in a position to take part in work to which they had been invited by a committee of the Royal Society, namely, assisting in the production of certain drugs which were necessary for the Army and Navy, and which at present could not be had from the ordinary sources of supply. He thought that was an encouraging circumstance. As to the capital, no one would doubt that that would be forthcoming if it were to be employed for the particular purposes of developing the chemical industries which had hitherto been in the hands of the Germans. But there remained the further point: Were the chemical manufacturers themselves ready to employ the scientific assistance which was needed, and were they ready to remunerate it adequately? Unless they recognised the necessity for the employment of the highest science in the development of their industries very little progress could be made. It was to the education of the masters of the industry that attention had to be devoted; it was those gentlemen who had to be converted. He might mention a fact in illustration of that. He, in his Government laboratory, had recently suffered from the want of chemicals which up to the time of the war there had been no difficulty in obtaining. The laboratory applied in succession to several manufacturers, but not one would undertake the manufacture. It certainly appeared, looking at the process given for the preparation of the particular substance in the text-books, as if it might be a troublesome thing to prepare, but it was essential to the laboratory's work. One of his staff thought he would look into the matter for himself, and in two days he produced a supply of the material adequate for immediate requirements. He could only account for the failure of the manufacturers to supply it on the supposition that they either had not the men in their service or were not willing that the men in their service should devote their time to the study necessary to master the details of the particular manufacture, although if they had manufactured it they would certainly have had a very handsome profit. He thought that showed the necessity of chemical manufacturers employing more largely than they did the scientific services which were now at their disposal in this country. He was glad to see the author had called attention to the fact that, after all, this country had contributed some of the great fundamental principles to chemistry. There was no want of originality in this country; there was no want of initiative; where we had got behind was simply in the power of organisation, or rather the failure to organise.

Mr. A. E. Berry said he had come to the meeting expecting to hear the manufacturers being hotly blamed for the existing state of things, and he admitted that in some instances they deserved that blame; but they had not always received the assistance and help which, in his opinion, should have been afforded to them. A few days ago one of the companies in which he was interested received an inquiry for a certain product that had always been made in Germany. That product required pure free spirit. Knowing from experience that there were very many difficulties and restrictions in procuring pure spirit, the company refused the order. Only the previous day, however, another company of his received the same inquiry, and after considering the matter they said they would make an attempt, and manufacture the product. His company then wrote to the Inland Revenue, saying they had accepted the business and must have duty-free spirit. That day he had received a visit from an officer of that department, who had spent an hour and a half arguing that the product must be made by something else than duty-free spirit. A similar state of affairs existed with regard to hydrosulphate. He claimed that manufacturers in this country had the knowledge and scientific ability to manufacture such a product,

but were debarred from doing so by the Government restrictions with regard to duty-free spirit. One great advantage which German manufacturers had over English manufacturers was with regard to postal facilities. In Germany many highly-priced chemicals and oils were often transmitted by post, and in that respect German manufacturers had an enormous advantage as compared with English manufacturers.

PROFESSOR A. G. GREEN, M.Sc., remarked that the question, as the author stated, was simply one of knowledge. The Germans had considered it was worth their while to pay in order to obtain knowledge; we had not, and until we had changed our methods we should still continue in the same old way. An instance had come under his notice a few days previously which showed the manner in which we were accustomed to proceed in this country. A certain firm in the North of England, of very considerable standing, had their attention directed to a certain substance, and were advised it would be a very profitable thing to take up. Instead of making inquiries as to where they would obtain the best scientific skill and advice as to the manufacture of it, or instead of engaging a chemist, they advertised for a workman who had made the product. They succeeded in getting a workman from a neighbouring manufactory, and the man then immediately said he must have a certain raw material. It was not to be obtained. Then they had to consider the question of manufacturing the raw material. They did not proceed to find out an expert in it, or an engineer to put down a plant, but proceeded to advertise for another workman with a knowledge of its manufacture. He (the speaker) did not know the sequel, but he thought it was pretty clear what it would be. Sir William Tilden considered there were no difficulties with regard to industrial alcohol at the present time. He (the speaker) was of that opinion until a month or two ago, but from inquiries he had made he was no longer of that opinion. The law as it stood would, he thought, if interpreted in a liberal manner, suffice to give all that was required, but as the law was now interpreted it did not. For instance, the price of ether in England was nearly three times as much as it was in Germany. That simply excluded the manufacture in England of a large number of materials in which ether was required. The Excise authorities absolutely refused to allow ether to be made from pure alcohol; it had to be made from industrial alcohol. That put a large extra cost on the manufacture of ether from several points of view. Acetic ether was another product which was debarred from being made from pure alcohol, because the Revenue people considered it would be possible to regenerate alcohol from the acetic ether! Ether was the starting-point of the manufacture of quite a number of fast yellow dyestuffs, which it was impossible to make in this country owing to the fact he had just stated. He did not mean to say that the alcohol question was one of premier importance. The question of the employment of chemists came first. The British manufacturer must employ a larger number of chemists, and he must reward those chemists sufficiently to make it worth their while to do their utmost.

[At this point Sir William Ramsay was compelled to leave the meeting, and the chair was taken by Professor J. M. Thomson, F.R.S.]

MR. A. CHASTON CHAPMAN said it had been truly stated that evening that there were manufacturers in this country who need fear no comparison with any Continental manufacturers. At the same time, the fact could not be hidden that there was a very large body of British manufacturers who imagined that the office was the central and most important part of their works, and that all they had to do was, that if they paid their chemists (if they employed scientific assistance at all) £100 per annum, to ensure that at the end of the year there was £150 in their till. It seemed to him that not only that section of the British manufacturers had to be educated, but also the British public, who in such matters were exceedingly ignorant; and it was through the British public that pressure could be brought to bear on the authorities—where pressure was very badly needed. He considered that this was the only country in the civilised world where chemistry was regarded as being synonymous with pharmacy. When one of the best-known evening papers had an article headed "Developments of Modern Chemistry," and then put under that heading details of new lines in tooth brushes and silver-mounted scent bottles, he considered something very drastic was required to be done. He pointed out that the brewing industry had recognised how much science could do for them. Many of the most important breweries had for many years employed chemists, not merely to examine their materials, but to investigate the conditions of the industry generally, and to see in what way fresh discoveries might conduce to its development.

MR. WALTER F. REID remarked that he was not one of those who grudged the Germans the slightest bit of profit they made out of their own inventions, but what he did say was that when an invention was made in this country and it had to go abroad to be worked, there was something radically wrong in the way the British inventor was treated. He could give dozens of instances where inventors had produced good ideas, but, owing to lack of help and opportunity, had had to let their ideas die or sell them for a mere song. That was not a healthy state of things. He might mention that he invented smokeless powder. In the first place he had taken it to a Government factory, and explained its properties. Some time after an official waited upon him and said that all he claimed for the powder had been proved, but that it could not be introduced into the Army

because, if it was, all the rifles would have to be altered! Was it not sickening to a British inventor when a thing of that kind occurred? There ought to be means available by which anything new of possible benefit might be developed. The Government should assist. British manufacturers were in the position of an untrained mob going against a drilled army, and the fault of that was in the collective effort of what was called the Government. But what was the Government in Great Britain, or the Government in Germany? It was the people, and if we would not combine to help each other it could not be wondered at if the enemy who had combined to beat us gained the victory. The commercial aspect of the matter was, in his opinion, of the greatest importance; he thought it went far beyond a knowledge of chemistry or anything else. The author in his paper had put the business man last. He (the speaker) ventured to suggest that some of the largest and best industries in the country had been developed in the first instance by good men of business. He agreed with Professor Green that chemists must be well paid, but in the first instance the business must be started before there would be anything out of which the chemist could be paid. Professor Green had mentioned the price of ether. Since the war broke out he (the speaker) had started two industries which had hitherto been chiefly carried on in Germany. He tried a third, and ether was one of the materials absolutely necessary. He had come to the conclusion it would be useless to start that industry, because the moment peace arrived the Germans would knock him clean out of the market. He always advised everybody that if they had plant they could utilise for the manufacture of an article let them do so as soon as possible, but if it was a question of spending thousands of pounds on the erection of a plant, unless they had some security that on the conclusion of peace things would not revert to the old unsound state when a foreigner was protected and the Britisher bled, then there was not the slightest chance of their making a profit, and he advised them not to spend the money. The Government were now going to put down public money to help to make certain things. Was that any better? He had yet to learn that a Government manufactory was conducted better than a private one. It all came down to the point that the Government were taking public money to put into a speculation in which a man who owned his own business hesitated to embark his own capital.

Colonel Charles E. Cassal (President of the Institution of Chemical Technologists), said he would attack the question from the point of view of the professional chemist. It was said that plenty of trained scientific chemists were necessary, but it was forgotten that in order to produce the trained scientific chemist a long period of technical education was necessary, which put a very severe tax upon the father of the young chemist. After that, he had to be offered something which was worth his while, and which would attract the right sort of man. What was offered at present to the young budding chemist who was to regenerate the chemical manufactures of this country? The other day he saw an advertisement in the *Chemical News* for a highly trained chemist, who had to be a university honours man, and the salary offered was £65 a year. Not very long ago the editor of a certain journal known as the *Chemical World* published an article in which he said that more trained chemists were wanted, men who would be willing to accept £150 to £200 a year as maximum salaries, in order to direct the operations of the chemical manufactories of this country. If the editor of a publication which was supposed to represent the interests of chemical manufacturers and of chemical technologists, placed the value of the services of a technical chemist at a maximum salary of that amount, and if in the *Chemical News* an advertiser considered he was going to have a highly-trained man for £65 a year, then in his opinion the objects the author had set out in his paper would never be attained. Many manufacturers in this country had followed the objectionable practice of appointing Germans as their chemists in preference to Englishmen, because the former were "cheaper." He hoped that an end would be put to this, and that no German chemists would ever again get appointments in England.

The Author, in reply, drew attention to the fact that he had excluded the question of the brewing industry from his consideration in compiling the paper. As he had said on many previous occasions, the brewing industry had set in the past a most remarkable example to the rest of the manufacturers of this country. He need only mention the names of Graham, O'Sullivan, and Horace Brown, who were scientific chemists and not common testers, engaged by the great breweries in which they worked to investigate their processes and follow them. They did not trouble with the quality of the barley or the quantity of the water and such like details, but investigated all questions connected with the production of the materials which were the subject of their manufacture. Colonel Cassal had referred to a very serious question—namely, the question of remuneration. He quite agreed that the remuneration offered was simply disgraceful. But it had to be remembered that there were hundreds of young German chemists in the same position. The difference between the system adopted in Germany and that in vogue over here was not that the German manufacturer offered a high rate of wage to start with; he offered only enough to enable a man to live modestly until he had shown what he was worth. The man in Germany was carefully selected to begin with; he had had a good training in scientific chemistry, and then he was brought into the works in order to learn his business. That was what the

British manufacturer never could see—that industrial chemistry could never be taught in a college; it could only be learnt in the works themselves. He had noticed two lines in a speech made the other day by Mr. J. G. Jenkins, formerly Premier of South Australia, at a meeting held in London, and he (the speaker) thought there was so much in the remarks that he ventured to read them. Mr. Jenkins said that "much nonsense was talked about the capture of German trade. A certain amount of that trade might be got now, but to keep it the manufacturer must deserve it."

A vote of thanks to the author for his interesting paper was put and carried with acclamation.

LES UNIVERSITÉS FRANÇAISES AUX UNIVERSITÉS DES PAYS NEUTRES.

[In reply to the manifesto recently put forward by certain German professors in defence of German civilisation and humanity, the French universities enumerated have issued the following appeal to the universities of neutral countries. The Royal Society of Arts has been favoured with a copy of this eloquent and convincing statement, and it is printed here in order that the Fellows may have before them the full text of a most interesting and impressive document.]

Les Universités Allemandes viennent de protester contre les accusations dont leur pays est l'objet à l'occasion de la guerre.

Les Universités Françaises se borneront à vous soumettre les questions suivantes:

Qui a voulu cette guerre?

Qui, pendant le trop court répit laissé aux délibérations de l'Europe, s'est ingénié à trouver des formules de conciliation? Qui, au contraire, a refusé toutes celles qu'ont successivement proposées l'Angleterre, la Russie, la France et l'Italie?

Qui, au moment précis où le conflit paraissait s'apaiser, a déchaîné la guerre, comme si l'occasion propice était attendue et guettée?

Qui a violé la neutralité de la Belgique, après l'avoir garantie?

Qui a déclaré à ce propos que neutralité est un mot, que "les traités sont des chiffons de papier," et qu'en temps de guerre "on fait comme on peut?"

Qui tient pour non avenues les conventions internationales par lesquelles les puissances signataires se sont engagées à n'user, dans la conduite de la guerre, d'aucun moyen de force constituant une "barbarie" ou une "perfidie" et à respecter les monuments historiques, les édifices des cultes, des sciences, des arts et de la bienfaisance, sauf dans les cas où l'ennemi, les dénaturant le premier, les emploierait à des fins militaires?

Dans quelles conditions l'Université de Louvain a-t-elle été détruite?

Dans quelles conditions la Cathédrale de Reims a-t-elle été brûlée?

Dans quelles conditions des bombes incendiaires ont-elles été jetées sur Notre-Dame de Paris?

A ces questions, les faits seuls doivent répondre.

Déjà, vous pouvez consulter les documents publiés par les chancelleries, les résultats d'enquêtes faites par des neutres, les témoignages trouvés dans des carnets allemands, les témoignages des ruines de Belgique et des ruines de France.

Ce sont nos preuves.

Contre elles, il ne suffit pas, ainsi que l'ont fait les représentants de la science et de l'art allemands, d'énoncer des dénégations, appuyées seulement d'une "parole d'honneur" impérative.

Il ne suffit pas davantage, comme font les Universités Allemandes, de dire: Vous connaissez notre enseignement; il n'a pu former une nation de barbares.

Nous savons quelle a été la valeur de cet enseignement. Mais, nous savons aussi que, rompant avec les traditions de l'Allemagne de Leibnitz, de Kant et de Gœthe, la pensée allemande vient de se déclarer solidaire, tributaire et sujette du militarisme prussien, et qu'emportée par lui, elle prétend à la domination universelle

De cette prétention, les preuves abondent. Hier encore, un maître de l'Université de Leipzig écrivait: "C'est sur nos épaules que repose le sort futur de la culture en Europe."

Les Universités Françaises, elles, continuent de penser que la civilisation est l'œuvre non pas d'un peuple unique, mais de tous les peuples, que la richesse intellectuelle et morale de l'humanité est créée par la naturelle variété et l'indépendance nécessaire de tous les génies nationaux.

Comme les armées alliées, elles défendent, pour leur part, la liberté du monde.

L'Université de Paris.
L'Université d'Aix-Marseille.
L'Université d'Alger.
L'Université de Besançon.
L'Université de Bordeaux.
L'Université de Caen.
L'Université de Clermont.
L'Université de Dijon.
L'Université de Grenoble.
L'Université de Lyon.
L'Université de Montpellier.
L'Université de Nancy.
L'Université de Poitiers.
L'Université de Rennes.
L'Université de Toulouse.

Le 3 Novembre 1914.

L'Université de Lille n'a pu être consultée.

A NOTE ON THE IMPROVEMENT OF COTTON IN BRITISH INDIA.*

During the rule of the East India Company, when the question of extension of cotton cultivation was first considered, the idea of improving the quality of the crop for the benefit of the people themselves was scarcely considered. A supply of superior cotton capable of competing with the product of America was the definite object of many trials which were undertaken since 1788 onwards.

* Abstract of a paper read by G. A. Gammie, Imperial Cotton Specialist, India, at the Third International Congress of Tropical Agriculture.

The final result of all these trials was that American cotton was introduced into cultivation in the Southern Mahratta Country of the Bombay Presidency, where it still exists. The perennial Bourbon established itself over small areas in Madras, and several species of foreign tree cottons occur in small numbers in gardens and temple enclosures throughout India.

On the organisation of the present Department of Agriculture in India, an attempt was made to find out what were actually the species of cotton in India, their conditions and possibilities of improvement, if such were considered necessary. At the same time many foreign varieties were tested; of the latter, it can be definitely said that all the tree cottons failed on extended trials, and of the exotic annual cottons only a few are promising enough to be persevered with. So far as our knowledge has taken us, it appears that American cottons of high quality can be grown successfully in the irrigated tracts of Sind, Punjab, and parts of United Provinces. In the southern parts of the Madras Presidency, Southern Mahratta Country, and Northern Guzerat there is a strong possibility that a variety of Upland from Cambodia will supply good cotton.

As regards the indigenous varieties, a precise knowledge of these has brought to light the fact that few varieties exist pure in any part of India, and the most valuable work done by the Department so far has been in the separation and extension of the best varieties in the mixtures. For instance, in the Madras Presidency the Karanganni is now grown free from the inferior admixture of the Uppam; in the Bengal areas the white-flowered cottons, on account of their high yield and hardiness, are ousting the other varieties in the mixtures. In other parts of the country where pure varieties have been found a certain amount of improvement has been effected in the staple and ginning percentage; a certain amount of good has also been effected by the substitution of superior for inferior varieties in some districts.

In conclusion, we learn that the purpose of the older experiments was to benefit primarily the English market. The present intention of the work in progress is to benefit the people of the country, and to provide, if possible, a surplus of higher quality for the use of foreign markets.

CONCILIATION COURTS IN FRANCE.

Conciliation Courts dealing with trade disputes between masters and workmen in certain specified industries have long existed in France, where they are known as "Conseils de prud'hommes." These tribunals are established by ministerial authority with the advice of the local chambers of commerce, industrial organisations, and municipal councils, in the important manufacturing and trade centres. Only one tribunal of this character may be established in any city, but it may be divided into independent sections. Workmen and employers are grouped in separate sections.

The "Conseils de prud'hommes" are composed of masters and workmen or employees in equal proportions, and there must be at least two manufacturers or merchants and two workmen or employees in each category, the former being elected by the masters and the latter by the workmen of their group. According to the American Consul-General at Marseilles, the members of the conseils are elected for six years, one half of the tribunal being renewed every three years. In order to take part in these elections the following qualifications are required, namely: (1) Registration on the political voting list; (2) to have attained the age of twenty-five years; (3) to have been engaged for three years, including apprenticeship, in one of the professions or trades mentioned in the decree establishing the court; and (4) one year's residence in the district.

All persons employing for their own account one or more workmen or employees and all members of firms, and managers and assistant managers of industrial and commercial enterprises, and engineers, vote in the category of masters. The electoral franchise is granted in this case to women of French nationality having the necessary qualifications of age, practice of profession or trade, and residence. Electors, including women who have attained the age of thirty years, who are able to read and write, and who have resided in the district for at least three years, and also former electors who have not abandoned their trade or profession for more than five years, and who have been engaged in the practice thereof at least five years within the district, may be chosen as members of these tribunals. Every year, within twenty days after the revision of the political voting list, the mayor of each town in the district, assisted by three electors taken respectively among the masters, workmen, and employees, and selected by the municipal council, writes down on separate lists the name, profession, and domicile of the electors belonging to the various categories. These lists are submitted to the Prefect of the Department for his approval and are afterwards posted in the clerk's office of the tribunal, and in the different town halls of the district. During the fortnight following this publication, application may be made to the local justice of the peace for the correction of the lists. The "prud'hommes," or judges of each section, elect among themselves, by secret ballot and majority vote, a president and vice-president. When the president is chosen among the workmen or employees, the vice-president must be taken among the masters and *vice versâ*.

The president must be in turn a master and a workman. The president and vice-president are elected for one year and may be re-elected. The presidents and vice-presidents of sections meet each year to elect among the former a president of the "Conseil de prud'hommes." One or more secretaries appointed by decree are attached to each tribunal. Each section of the conseil

comprises: (1) a "bureau de conciliation," or conciliation board, and (2) a "bureau de jugement," or judgment board. The conciliation board is composed of one workman or employee and one master. The meetings of this board are held at least once a week, and are not open to the public. The judgment board is composed of an equal number of workmen or employees and masters, including the president and vice-president, who preside in turn. This number includes at least two masters and two employees or workmen.

EMPIRE NOTES.

The Annexation of Cyprus.—In 1878 Cyprus became a British possession, under the terms of a convention between Great Britain and Turkey, by which, on the payment of an annual rent of £92,800, that island was leased by Turkey to Great Britain. Now, by the fortune of war, as we confidently assume that victory will crown the arms of the Allied Forces, that rent will cease to be paid and Cyprus will become an integral part of the British Empire. The island, which has an area of 3,584 square miles and a population of about 290,000, is 900 miles from Malta, and is the third of the important naval bases which Britain possesses in the Mediterranean, the first and most important being, of course, Gibraltar. It may be truly said that from time immemorial it has been the prize of sea power in the Mediterranean. The Phœnicians were among its earliest rulers, and the Greeks succeeded them. As the centuries passed it fell, in succession, under Assyrian, Egyptian, Persian, Macedonian, and Roman rule, and was twice conquered by the Saracens. The English king, Richard I., captured it on his way to the third crusade, and gave it to King Guy of Jerusalem, with whose dynasty it remained till it fell into the hands of the Venetians. In 1570 it was invaded by the Turks, and captured by them after desperate fighting. In the hands of the Turks it continued for three centuries, and under them it steadily declined. According to the convention above referred to, Cyprus is to remain British so long as Kars, Batum, and Poti, which, in 1878, were ceded to Russia by Turkey, remain Russian. The original object in obtaining its cession was to give England a coaling station in the eastern Mediterranean, close to the Suez Canal, from the Mediterranean entrance to which Cyprus is distant only 220 miles, and near the Mediterranean terminus of the Baghdad Railway, which was then projected across southern Asia Minor to India. The occupation of Egypt, however, in 1882, rendered a coaling station unnecessary, since British warships could use the ports of Alexandria and Port Said, while at Cyprus there was no good harbour. Therefore, until 1899 very little was done to develop the interests of the island. But in that year a loan of £314,000 was granted by the British Government, to construct irrigation works, to build railways, and improve the harbours. Sanitation also has been improved and the death-rate greatly reduced. All this has done much to improve the island and to render it a pleasure resort, and to promote its agricultural and viticultural resources. Its chief products are corn, wine, cotton, raisins and fruits.

An Imperial Highway.—One of the arguments in favour of the construction of the Canadian Pacific Railway, years ago, was that it would prove an important Imperial highway between the United Kingdom and India, as troops might be conveyed by it, in case of need, from England to India. But although that particular necessity has happily not arisen, the C.P.R. has been able to render great service to the Dominion of Canada and to the Empire in various ways—first, by the rapid transport of troops across the continent from British Columbia and the western prairies to Quebec, Halifax and St. John; secondly, by placing at the service of the naval authorities a number of their best ships, now transformed into auxiliary cruisers, which are to-day traversing the seas to defend our trade routes, and to look for the ships of the enemy; and, thirdly, by making large contributions from the company itself and their staff to the war relief funds, and by the personal services of many of their men. So far as the transport work is concerned, it is gratifying to know that the arrangements made for handling the troops and for looking after their general comfort were all carried out without interfering with the company's current time-tables. The public were, therefore, in no way inconvenienced, while, at the same time, a service was rendered to the Empire of the greatest value.

The Commonwealth Wheat Position and Prospects.—According to the *Australian Insurance and Banking Record*, the stocks of wheat and flour at present in the Commonwealth leave only a moderate surplus available for export before next harvest, after providing for Australian consumption. The last harvest, as shown by official returns, amounted to the record total of 103,589,369 bushels. After providing for consumption of food and seed, this total would leave an exportable surplus, for the whole season, of between 65 and 70 million bushels. Allowance, however, would have to be made for a certain quantity of stock to be carried over at the end of the season, and for the possibility of over-estimates. Since the middle of last December the exports from the Commonwealth, including flour reduced to the equivalent of wheat, have amounted to nearly 60,000,000 bushels, so that most of the surplus has been exported. As regards prospects for the present season, it is stated that the New South Wales area sown for grain is officially estimated at 3,556,386 acres, or an increase of 350,989 acres as compared with the season 1913-14, while the Victorian area from grain is officially estimated at 2,679,500 acres, or an increase of 113,639 acres, making a total increase of 464,628 acres in the

two States, which, last season, represented about 62 per cent. of the total area under wheat in the Commonwealth. Unfortunately, in a considerable area of Victoria and New South Wales, and of other States also, the rainfall, until recently, has not been more than sufficient for current progress. So long, therefore, as the course of the weather continues problematic, the farmers will be unwilling to sell the remainder of their wheat held over since last season, and for this reason, if for no other, a firm market would be experienced, apart from the influence of the war. To meet the exigencies of the war, efforts are being made to continue, as far as possible, the exportation of wheat and other foodstuffs to the United Kingdom and to our Allies. This applies also to the exportation of hides and skins, which, by a recent proclamation, is prohibited, without the consent of the Minister of Customs, with a view to preventing the articles from reaching the enemy. The extensive purchases of Australian sheepskins by American merchants has caused comment, in view of previous limited shipments to the United States. It is believed that the ultimate destination of a large quantity of these purchases would be Germany. This will henceforth be controlled by the regulation of exports of hides and skins now to be enforced. Similar provisions are being made in New Zealand in regard to the export of wool, which had previously been adopted in reference to that article in Australia. By these timely and practical measures, Australasia is seeking to help the Mother Country by foiling the attempts of the enemy to obtain the raw materials so urgently required by Germany and Austria.

The Question of Responsible Government in Rhodesia.—By Clause 33 of the British South Africa Company's Charter of October 29th, 1889, the power is reserved to the Crown, at the end of twenty-five years from the date of the Charter, and at the end of every successive period of ten years, to add to or repeal any of the provisions of the Charter relating to administrative and public matters. Failing the exercise of this power by the Crown at the end of these prescribed periods, the Charter is automatically extended for another ten years. Last year, when the twenty-five years stated in the document of 1889 had expired, an election was held, at which a vote was taken on the question of responsible government. The result of that election, it will be remembered, was that the advocates of responsible government for Southern Rhodesia were decisively defeated, and the rule and governance of the Company were fully confirmed. It was therefore concluded that there would be no interference with the administrative position of the Company for another ten years. The directors of the Company, however, have recently informed the Colonial Secretary that they would not regard the non-exercise by His Majesty of his right of reviewing the provisions of the Charter during the next decennial period as any bar to the establishment of responsible government should the time appear to be ripe for such a step; and that if, during these ten years the inhabitants of Southern Rhodesia should find that they were financially and in other respects strong enough to assume, with the concurrence of His Majesty's Government, the burden of administration, and should express, through the Legislative Council, their desire to assume that burden, they, the directors, would be most willing to give effect to that desire. In view of this liberal and broad-minded attitude on the part of the Company, the Government have decided not to exercise their powers, but in due course will issue a Supplementary Charter giving effect to the arrangement to which the Company have agreed, in respect of the possible future establishment of responsible government.

CORRESPONDENCE.

MAP-MAKING AND TAPESTRIES.

In the course of his extremely interesting and enlightening remarks upon map-making at the opening meeting of the session, our Chairman of Council, Sir Thomas Holdich, referred to the lead given to Europe in the sixteenth century by Dutch map-makers. In this connection I should like to draw attention to English sixteenth and seventeenth century map tapestries, lent to the Victoria and Albert Museum and now exhibited there. Some are complete and large wall hangings of pictorially conventionalized maps of Warwickshire, Oxfordshire and adjacent counties; some are mere fragments. Long accounts of their origin, of presumptions as to the engraved maps from which the tapestry weavers' cartoons may have been made, of circumstances of their preservation, etc., are placed near them, but there is, as well as I can remember, no suggestion of their relationship to similar styles of tapestries made in Holland at corresponding, if not at earlier, times. For instance, I saw in April this year a well-preserved specimen of kindred topographical character hanging in the Municipal Museum of Leyden. Its subject is the relief of Leyden in 1574, and the tapestry was made in Delft from cartoons by Liefring and Swanenburg. Tapestry manufacture at Delft was carried on under the direction of Francis Spiring, or Spierinx, and one class of the designs which he adopted was of a character at least allied to that of the English map tapestries—that is to say, it was pictorially diagrammatic, so to speak. Similar pictorially diagrammatic tapestries woven late in the sixteenth century at Middleburg hang in the Council Chamber in the extensive buildings of the old Abbey there. These tapestries represent the naval battles between the Dutch Maritime Provinces and the Spaniards, and are also of a distinctly topographical design, similar to one or two specimens now at Hampton Court Palace, of engagements between the English and Spanish

Fleets in 1588. These Middleburg and Hampton Court tapestries were woven from designs by H. Cornelius Vroom of Harlem. Was he a map-maker as well?

Sir Thomas Holdich told us how Jerusalem was indicated by old map-makers as being the centre of the world. The pilgrimage of Otto Heinrich, Count Palatine and Duke of Bavaria, to the Holy Sepulchre at Jerusalem, in 1521, is the subject of a mixed topographical and special, or story-telling design, woven in a large tapestry hanging now in the Industrial Art Museum of Munich. In this is represented a detailed view—more Dutch than Oriental—of Jerusalem set in the midst of hills.

These, then, are a few instances of topographical designs and their production in the sixteenth and seventeenth centuries as tapestries. I venture to suggest that the authorities of the Victoria and Albert Museum might well develop their inquiries in this direction in order to encourage the study and comparison of kindred classes or types of design for tapestry weaving. Their minute investigations to prove the English or other national origins of tapestries are perhaps delightful as antiquarian and ethnological pursuits, but these are not very helpful to the student of phases of decorative design in its relation to manufactures, and this is surely the prime educational purpose of the Victoria and Albert Museum.

Alan S. Cole.

November 20th, 1914.

OBITUARY.

Alfred Sang.—Mr. Alfred Sang was born in Paris in 1876. His parents were English, and he was educated, first in France, later at Ratcliffe College, England, and subsequently at the Conservatoire National des Arts et Métiers in Paris. He was possessed of considerable mathematical and mechanical ability, and before going to the United States, in 1900, he invented a calculating machine. In Pittsburg he was identified with the Garland Companies, and specialised on the corrosion of metals and metallic coatings for the prevention of corrosion. He wrote a book on this subject, and was a well-known contributor to many scientific publications. Returning to Paris in 1909, he founded the company of Sang and Rafinesque, metallurgical engineers, and later on he established the firm of Sang and Russell in London. On the outbreak of the war he at once volunteered for the Intelligence Corps. He was especially fitted for this service as he spoke French and English equally well and had also a thorough knowledge of German. The roads of Northern France were perfectly familiar to him, as he was an ardent cyclist. Unfortunately he was wounded in the head early in September, and died in the British Military Hospital at Rouen on October 2nd. Mr. Sand was elected a member of the Royal Society of Arts in 1911.

NOTES ON BOOKS.

The Guitar and Mandolin: Biographies of celebrated Players and Composers for these Instruments. By Philip J. Bone. London: Schott & Co. 1914.

This book, as the author states in his preface, is the result of his coming up to the Society's Examinations in Practical Music in 1897, when he obtained the Society's Medal. Dr. John Farmer, the examiner, was so struck with his playing that, with his usual kindliness, he kept up a correspondence with Mr. Bone, in which he strongly urged him to devote himself to the study of music and musical history.

The book itself is really a biographical dictionary of players on the two instruments mentioned, and of composers of music for them. It shows a very great amount of research, and may be taken to include a complete account of all known guitar and mandolin players, while it also includes a large number of well-known composers who wrote music intended for the mandolin or guitar, though they certainly cannot be said to have devoted themselves in any sense to the special production of such music. For instance, Beethoven, Berlioz, Gounod, Mozart, and very many other well-known names are all included. But to judge from the pains evidently taken by the author in the production of the book, it may fairly be assumed that as regards players of the two instruments mentioned, it may be accepted as exhaustive.

The illustrations, which are all reproductions of portraits, are not very satisfactory, though they certainly add to the interest of the book.

Celtic Scribe Work. By J. F. Maxwell. Dublin and Belfast: The Educational Company of Ireland. 9*d*.

This is a copy-book in which the author has collected some specimens of Celtic script. They are, for the most part, examples in outline taken from "The Book of Kells," "The Book of Durrow," and "The Book of Lindisfarne," though a few original pieces based on designs from these manuscripts have also been added. The extraordinary beauty of the work of the Celtic scribes is, of course, familiar to most people, and although much of it is due to the beautiful colouring of which they were masters, still it is wonderful to see how much remains when only the bare outline is left. One of the most striking pages is that containing examples of interlaced repeating borders, where are shown the different effects produced in precisely the same outlines by varieties of shading.

The art of illumination is a very beautiful one, and no country has produced finer work of this kind than Ireland. It is to be hoped that the production of this copy-book may achieve the end which the author had in view—"enable the student to grasp the most salient characteristics of Celtic art, and so lead him on to the study of the more ambitious works on what is generally admitted to be the most beautiful script in the world."

GENERAL NOTES.

THE PANAMA-PACIFIC EXPOSITION.—The United States Government has placed its steamship "Jason" (15,000 tons) at the disposal of all British exhibitors who desire to take part in the Panama-Pacific Exposition, to be held at San Francisco. The "Jason" has just reached this country with Christmas presents for the children who have suffered bereavement through the war, and is expected to sail on her return journey from Plymouth or Falmouth about January 1st. She will go through the Panama Canal and take British art and industry exhibits direct to the exhibition wharf in San Francisco, without any charge for freight. A notable advantage of this arrangement is that it assures the safety of all exhibits from a British port to the Exposition through waters that have recently been visited by German cruisers. British firms desirous of availing themselves of the "Jason" are asked to communicate, as soon as possible, with the Exposition's London offices, Trafalgar Buildings.

ALUMINIUM.—Some interesting figures representing the remarkably rapid development in the production of aluminium were given by Mr. H. N. Munro, in a paper recently read before the Junior Institution of Engineers. The price per ton in 1889 was £3,256, in 1891 it was £812, and it has decreased until now it is in the neighbourhood of £80. As aluminium is one of the lightest of metals, weighing 160·167 lbs. per cubic foot, it is greatly in demand where light weight is of importance. It is very malleable and ductile, does not tarnish or rust, and is not affected by the action of water. The metal is produced electrically from alumina, an oxide of aluminium, which is obtained from bauxite, a clayey ore containing about 55 to 56 per cent. of alumina. For electrical purposes aluminium is fast becoming common. Overhead transmission lines constructed in aluminium show a great saving over equivalent copper lines, a saving of as much as 10 to 25 per cent. being effected, according to the size and nature of the system erected. Its freedom from corrosion renders it an admirable metal for use on lines in the vicinity of chemical works, etc., and in seaside places, where the air is permeated with salt, etc. Among the aluminium lines erected in this country are:—Three-phase H.T. lines from Aldershot to Enshott, and from Tidworth to Bulford, both for the War Office, lines for Weardale Steel, Iron and Coal Company; Ebbw Vale Steel, Iron and Coal Company, North Wales Power and Traction Company, Fife Coal Company. For insulated cables, aluminium is extensively used, particularly on the Continent, where some hundreds of miles of aluminium mains, principally paper head covered, are laid. For very small cables and heavily-armoured cables, aluminium may now show up to the same advantage as for ordinary sized cables, but even in those two classes aluminium cables can effect a saving of 5 per cent. and upwards, according to the design of the cable. The joining of aluminium cable in the earlier days was a difficult problem, and is still regarded as a great drawback to the use of aluminium. Provided, however, that the joints are carefully made and all moisture excluded, aluminium can be easily and effectively jointed. Many kinds of mechanical clamps are available which are very effective. The uses of aluminium in the manufacture of magnet coils, for use as bus bars and battery connections was described. For use in the construction of railway and motor vehicles for domestic, military, and general purposes, aluminium finds an extensive field.

THE DAIRY INDUSTRY IN EASTERN SIBERIA.—There is a shortage of meat and milk cattle in the Maritime Province. Most of the meat is received from neighbouring countries, while the butter supply comes from western Siberia. These conditions have awakened considerable interest in the development of breeding local cattle to furnish necessary supplies, and steps are being taken by the Government to give strong support to this industry, which is a growing one. In the opinion of scientists, a further plan of teaching the peasantry methods of keeping and feeding cattle, and caring for the young animals, will have a good influence on its development. Nearly all dairy products are obtained during the four summer months. As the population knows little about local butter, and as the dealer is bound by contracts with western Siberian firms, they have not taken sufficient interest in it, for which reason the marketing of local butter has not been easy. Until the population becomes acquainted with local products, the agronomical organisation sees the necessity of controlling the sale of these meat products. The estimates of this organisation for the year 1914 contain sums for the construction of a Government cold-storage plant at Vladivostok, and a similar one will soon be constructed in Habarofsk.

PRICES OF PROVISIONS ON THE FRENCH RIVIERA DURING WAR TIME.—The *Commission d'Alimentation*, of the Department of the Alpes Maritimes, with a view of regulating the cost of provisions in this Department, have fixed the following prices as the limit to be charged: wheat, 28 francs per quintal (11*s*. 8*d*. per English cwt.); flour, 39·50 francs per quintal (16*s*. 0½*d*. per cwt.); and rice, 37 francs per quintal (15*s*. per cwt.). Owing to the intervention of the municipality the price of bread at Nice has not risen, and remains as it was before the war at 45 centimes per kilogram (2*d*. per lb.). Sugar, the retail price of which ranged from 60 to 70 centimes per kilogram (2¾*d*. to 3¼*d*. per lb.), has lately risen to as much as 1·30 francs per kilogram (6*d*. per lb.). A good light table red wine (*vin ordinaire*) of this year's vintage is now retailed as low as 35 centimes per litre (2*d*. per pint) as compared with 50 centimes per litre last year.

Vegetables and fruit are plentiful and cheap, with the exception of potatoes, which have risen considerably in price. Eggs and butter are slightly dearer than last year.

IRON IN ANCIENT INDIA.—A great deal of scattered but highly interesting information regarding the manufacture of iron in India in early times has been brought together in a pamphlet by Mr. Panchaman Neogi, Professor of Chemistry at the Rajshahi College. He finds evidence of its manufacture in India as far back at least as 2000 B.C., and from a passage in the "Black Yajurveda" it seems that some form of iron cannon had been used in the Vedic age between 2000 and 1000 B.C. Later, between 500 and 200 B.C., iron appears to have been largely used, more especially for warlike weapons. Probably, however, the most remarkable instance of its employment appears in a medical work describing nearly one hundred surgical instruments used for most delicate operations, a piece of evidence which seems to show that the manufacture of steel must have been well understood. From certain burial sites in the district of Tinnevelly iron swords and daggers have been unearthed, but the exact age of these cannot be fixed, though they are believed to have come down from prehistoric times, and specimens of third-century iron have been recovered from Buddha Gaya. The iron pillar near the Kutub Minar, Delhi, is of course well known, while the relics at Konarak and Puri are also celebrated. The date of the former is ascribed to A.D. 640, and that of the rectangular iron beams at Puri to A.D. 1174. The sixteenth century saw the first manufacture of cannons in India, when some of a remarkable size were turned out. The reader will find it difficult, after perusal of Mr. Neogi's pamphlet, to understand how it has come to pass that metallurgical experience and knowledge should have disappeared to such an extent from the country as it now appears to have done.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock :—

DECEMBER 2.—WILLIAM REGINALD ORMANDY, D.Sc., F.C.S., "Britain and Germany in Relation to the Chemical Trade." The Right Hon. LORD MOULTON, LL.D., F.R.S., will preside.

DECEMBER 9.—WILLIAM A. YOUNG, "Domestic Metal Work of the Eighteenth Century." PROFESSOR WILLIAM GOWLAND, F.R.S., will preside.

DECEMBER 16.—SIR WILLIAM DE WIVESLIE ABNEY, K.C.B., D.C.L., D.Sc., F.R.S., "Testing Pigments for Permanence of Colour."

INDIAN SECTION.

Thursday afternoon, at 4.30 o'clock :—

DECEMBER 17.—DR. F. MOLLWO PERKIN, F.I.C., F.C.S., "The Indian Indigo Industry." SIR STEUART COLVIN BAYLEY, G.C.S.I., C.I.E., will preside.

Papers to be read after Christmas :—

F. VINCENT BROOKS, "British Lithography in 1915."

Hon. JOHN COLLIER, R.O.I., "Portrait Painting."

OCTAVIUS CHARLES BEALE, Chairman of the Australian Manufacturers' Association, "Imperial Industrial Development after the War."

THOMAS WORTHINGTON, "The Work of the Commercial Intelligence Branch of the Board of Trade."

T. THORNE BAKER, "The Industrial Uses of Radium."

FRANK BAINES, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

G. W. HULME, "Patent Law."

W. T. THORNTON, "The Industrial Uses of Coal Gas."

D. Y. CAMERON, A.R.A., R.E., "Etching."

ROGER FRY, "Post Impressionism in Design."

C. H. SHERRILL, "Ancient Stained Glass."

WILLIAM POEL, "Shakespeare's Profession."

ARTHUR WILCOCK, "Designing for Textiles."

J. A. HUNTER, "The Textile Industries of Great Britain and of Germany."

EDWARD R. DAVSON, "Colonial Sugar Development."

HENRY JOHN ELWES, F.R.S., "Nepal."

CAPTAIN SIR GEORGE DUFF DUNBAR, Bart., I.A., "Tribes of the Brahmaputra Valley."

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock :—

January 21, February 18, March 18, April 15, May 13.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

February 2, March, 2, 30, May 4.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

R. A. PEDDIE, Librarian, St. Bride Foundation Typographical Library, "The History and Practice of the Art of Printing." Four Lectures.

LECTURE II.—NOVEMBER 30.—*The 19th Century.* In 1801 no machine production—Stanhope press—Type faces 1801-40—Revival of old style printing

and Caslon type—Machine-made paper—Development of the printing machine—Invention of photography—Attempts at colour printing.

LECTURE III.—DECEMBER 7.—*The 19th and 20th Centuries continued.* Woodcuts of the Sixties —Invention of the half-tone—Revival of hand-press work for artistic production—Effect of revival on commercial work—Types and Typefounders—Recent inventions in illustration.

LECTURE IV.—DECEMBER 14.—*The later history of colour printing*—Rise of chromo-lithography—Chromo-xylography—The three-colour process—Collotype—Photogravure and its combinations—The offset process.

DR. F. MOLLWO PERKIN, F.I.C., F.C.S., "Oils, their Production and Manufacture." Three Lectures.

January 18, 25, February 1.

M. H. BAILLIE SCOTT, "House Building Past and Present." Three Lectures.

March 15, 22, 29.

DAVID SOMMERVILLE, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

FOTHERGILL LECTURES.

Monday evenings, at 8 o'clock:—

PROFESSOR VIVIAN B. LEWES, F.I.C., F.C.S., "Motor Fuel." Three Lectures.

February 15, 22, March 1.

JUVENILE LECTURES.

Wednesday afternoons, at 5 o'clock:—

H. PLUNKET GREENE. Two lectures, with vocal illustrations.

January 6, 13.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, NOVEMBER 30...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. R. A. Peddie, "The History and Practice of the Art of Printing." (Lecture II.)

Brewing, Institute of (London Section), The Imperial Hotel, Russell-square, W.C., 8 p.m. 1. Annual General Meeting. 2. Mr. H. E. Field, "What Economies, if any, are possible in the Brewery to-day?"

Actuaries, Institute of, Staples Inn Hall, Holborn, W.C., 5 p.m. Inaugural Address by the President, Mr. Ernest Woods.

TUESDAY, DECEMBER 1...Illuminating Engineering Society, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. L. Gaster, "Illuminating Engineering in War Time. Some Lessons to be learned from the present lighting of London."

Civil Engineers, Institution of, Great George-street, S.W., 8 p.m. 1. Mr. J. B. Ball, "Tests of Reinforced-Concrete Structures on the Great Central Railway." 2. Mr. S. H. Ellis, "Corrosion of Steel Wharves at Kowloon." 3. Mr. J. Hammersley-Heenan, "Concreting in Freezing Weather and the Effect of Frost upon Concrete."

Photographic Society, 35, Russell-square, W.C., 8 p.m. Mr. G. B. Clifton, "The Bromoil Process."

Horticultural Society, Vincent-square, Westminster, S.W., 3 p.m.

Roentgen Society, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 8.15 p.m.

Medicine, Royal Society of, 1, Wimpole-street, W., 5 p.m. Dr. D. B. King, "Some Recent Experiences of Germany in War Time (during Detention in Germany) and their Lessons."

WEDNESDAY, DECEMBER 2...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Dr. W. R. Ormandy, "Britain and Germany in Relation to the Chemical Trades."

Public Analysts, Society of, at the Chemical Society, Burlington House, W., 8 p.m. 1. Dr. S. J. Lewis, "Application of Spectrography to Analysis." 2. Messrs. E. R. Bolton and E. M. Jesson, "Note on some Oleaginous Seeds." 3. Mr. G. N. Huntly, "Corrections in Bomb Calorimetry." 4. Mr. G. D. Elsdon, "Note on the determination of Sulphates in Flour."

Entomological Society, 11, Chandos-street, W., 8 p.m.

Royal Archæological Institute, at the Society of Antiquaries, Burlington House, W., 4.30 p.m. Dr. Annie Abram, "Misericords in Bruges Cathedral."

Civil Engineers of Ireland, Institution of, 35, Dawson-street, Dublin, 8 p.m.

Medicine, Royal Society of, 1, Wimpole-street, W. Section of Ophthalmology, 8 p.m. Mr. H. B. Grimsdale, "The Necessity for an Exact Definition of Blindness."

THURSDAY, DECEMBER 3...Royal Society, Burlington House, W., 4.30 p.m.

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Linnean Society, Burlington House, W., 8 p.m. 1. Mr. R. C. McLean, "An Ecological Journey in South America." (Illustrated by lantern-slides.) 2. Messrs. C. West and Hisayosin Takeda, "On *Isoetes japonica*, A. Br."

Child Study Society, at the Royal Sanitary Institute, 90, Buckingham Palace-road, S.W., 7.30 p.m. Margaret Conner, "Self-Expression through Language with Older Children."

Chemical Society, Burlington House, W., 8.30 p.m. 1. Mr. H. V. A. Briscoe, "A Redetermination of the Atomic Weight of Tin." 2. Messrs. O. D. Brady and F. P. Dunn, "The isomerism of the oximes. Part VI. p-Dimethylaminobenzaldoxime." 3. Messrs. F. Challenger and C. F. Allpress, "Organo derivatives of bismuth. Part II.—The stability of derivatives of quinquevalent bismuth."

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Rev. J. Stephenson, "The Bible; its Manuscripts and Translations."

Concrete Institute, 296, Vauxhall Bridge-road, S.W., 7.30 p.m. Mr. H. Kempton Dyson, "Shear and Problems arising therefrom."

Art Workers' Guild (Junior), 6, Queen-square, W.C., 8 p.m. Mr. G. P. Bankart, "The Decorative Uses of Plaster."

FRIDAY, DECEMBER 4...Chadwick Public Lecture, at the London School of Economics, Clare Market, W.C., 8.15 p.m. Sir R. Ross, "Government and Military Sanitation in the Tropics." (Lecture I.)

Geologists' Association, University College, W.C., 8 p.m.

Engineers, Junior Institution of, 39, Victoria-street, S.W., 8 p.m. Mr. S. E. Hutson, "A Reversible Turbine."

Journal of the Royal Society of Arts.

No. 3,237. VOL. LXIII.

FRIDAY, DECEMBER 4, 1914.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, DECEMBER 7th, at 8 p.m. (Cantor Lecture.) R. A. PEDDIE, Librarian, St. Bride Foundation Typographical Library, "The History and Practice of the Art of Printing." (Lecture III.)

WEDNESDAY, DECEMBER 9th, at 8 p.m. (Ordinary Meeting.) WILLIAM A. YOUNG, "Domestic Metal Work of the Eighteenth Century." PROFESSOR WILLIAM GOWLAND, F.R.S., will preside.

Further particulars of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, November 30th, MR. R. A. PEDDIE delivered the second lecture of his course on "The History and Practice of the Art of Printing."

The lectures will be published in the *Journal* during the Christmas recess.

JUVENILE LECTURES.

The usual short course of lectures adapted to a juvenile audience will be delivered on Wednesday afternoons, January 6th and 13th, 1915, at 5 p.m., by MR. H. PLUNKET GREENE, on "How to Sing a Song."

Special tickets are required for these lectures. They can be obtained on application to the Secretary.

A sufficient number of tickets to fill the room will be issued to Fellows in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions, each Fellow is entitled to a ticket admitting two children and one adult. Fellows who desire tickets are requested to apply for them at once.

LIST OF FELLOWS.

The new edition of the List of Fellows of the Society is now ready, and can be obtained by Fellows on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

THIRD ORDINARY MEETING.

Wednesday, December 2nd, 1914; the RIGHT HON. LORD MOULTON, P.C., LL.D., F.R.S., in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Smith, Rev. Professor Samuel George, D.D., LL.D., Ph.D., St. Paul, Minnesota, U.S.A.

Tyrer, Thomas, F.I.C., F.C.S., 14, Sandwell Mansions, West End-lane, N.W.

The following candidates were balloted for and duly elected Fellows of the Society:—

Agramonte, Albert Arthur, Assoc.M.Am.Soc.C.E., Direccion de Desagües, Dolores, Argentina, South America.

Baijal, Kewal Ram, Chandni Chowk, Delhi, India.

Baldwin, John Brake, 6, Phillimore-terrace, Kensington, W.

Barth, Jakob Christian, British Vice-Consul, Sundsvall, Sweden.

Bell, William, C.I.E., M.A., 16, Summerside-place, Trinity, Edinburgh.

Bhandarkar, Hon. Chief Justice Vasudeo Gopal, Baroda, Baroda State, India.

Bilstein, Emma L., M.D., The Mount Royal, Baltimore, Maryland, U.S.A.

Bullough, Charles John Robert, The Willows, Warwick Road, Bounds Green, Middlesex.

Burnett, Eric Vaughan, M.Inst.M.M., Villas Harrington No. 7, Camino Cintura, Playa Ancha, Valparaiso, Chili, South America.

Carr, George, 22, Clapton Common, N.E.

Clarkson, Thomas, Talara, Payta, Peru, South America.

de Quesnel, George Marinus, c/o Messrs. Edwards & Sons, 57, Moorgate-street, E.C.

Duggall, Dewan Hari Gopal, Wazirabad, Gujranwala District, Punjab, India.

Dunlap, Professor Frederick, University of Missouri, Columbia, Missouri, U.S.A.

Gould, Charles Newton, Ph.D., 408, Terminal Building, Oklahoma City, U.S.A.

Gray, Mrs. Horace, c/o Messrs. Baring & Co., 8, Bishopsgate, E.C.

Gunn, James, 9, Gladstone-street, Hartlepool.

Gupta, Karunakumar Dutta, M.A., B.E., 70, Lansdowne-road, Calcutta, India.

Harrison, Cecil Reeves, B.Sc., Woodcote, Chislehurst, Kent.

Hill, Lewis George, 5, Oxford-road, Acocks Green, Warwickshire.

Langton, Miss Eveline Charlotte, Underhills, Beech-road, Reigate, Surrey.

Lewis, Rev. Edward Pilcher, D.D., St. George's Parsonage, 4 Rua da Estrella, Lisbon, Portugal.

Mackillop, John Archibald, Cumbrae, Mosman, Sydney, New South Wales, Australia.

Mews, John, LL.M., 90, Westbourne-terrace, W.

Munavery Sahib, Dr. P. M. I., Chalai P.O., Trivandrum, South India.

Narain, Parshottam, Farrukhabad, United Provinces, India.

Nash, Alfred William, Apsheronskaya, Kuban Province, South Russia.

Recke, George Philip, St. Thomas, Danish West Indies.

Rodger, Norman, 131, Cromwell-road, S.W.

Rogers-Moore, Mrs. Alice, 132, Winsor-avenue, Watertown, Massachusetts, U S.A.

Royce, William Stapleton, J.P., The Hall, Pinchbeck, Spalding

Sen, Hon. Rai Bahadur Nisi Kanta, B.L., Purnea, India.

Sircar, D. K., Sukchar Dyeing Factory, Sukchar P.O., 24, Purgannas, Bengal, India.

Skeet, George William, The Blue Coat School, Frome, Somerset.

Smith, Henry Lee, M.A., M.D., 2701, Calvert-street, Baltimore, Maryland, U.S.A.

Taylor, Guy Arthur, B.A., Solwezi, Northern Rhodesia.

Thornton, Horace Moore, The Richmond Gas Stove & Meter Co., Ltd , 132, Queen Victoria-street, E.C.

Westgate, John Minton, United States Department of Agriculture, Washington, D.C., U.S.A.

The Chairman (the Right Hon. Lord Moulton, P.C., LL.D., F.R.S.) said, that owing to public business he would, to his regret, be compelled to leave the meeting before the paper was read. He was glad, however, of the opportunity of being able to impress upon them that which the last few weeks had impressed upon him more deeply than he could express. He had had allotted to him for several weeks past the business of investigating into the question of the supplies of articles of which we were now deprived by reason of the war with Germany—that was to say, articles which in peace time were imported from that country. It would occur to all of his hearers that, first and foremost of those had been the problem of the great chemical trades, especially the great industry in synthetic dyes, and he had had an opportunity of marking in detail those things in which England had allowed herself to be supplied in chemicals from Germany. He could assure the audience that he had noted the fact with great sadness, and, he was bound to say, it was a great national humiliation. The fact was that chemistry opened up, especially some fifty years ago, a domain of industrial wealth which he could only compare to the domain which was opened up when steam power was first invented; and to his great sorrow he could come to no conclusion but one, and that was, that either from being too well off, or from sluggishness of intellect, or from the fact that the capital of the country had passed into the hands of people who were unwilling either to learn or to think, England had abstained almost entirely from attempting to reap the rich harvest that was opened to the industrial world by the advances in organic chemistry. The fact was too well marked for us to pass it by as being a mere incident in national life. Of course, no one thought that every nation could do everything; and that nations should, to a certain extent, specialise, should take advantage of their natural position, and the deposits that they found in their land, their climate, and things of that kind, was not only normal but desirable. But thought depended on no climate. Thought was open to us all; and the fact that England neglected the chemical industries could not be explained away by any suggestion that it was either incapable or for any natural reason unfitted for their pursuit. One had to look deeper than that. One had to find some fault either in the national character or in the national behaviour which would account for it; and he did not believe that England could, after the war, survive as a great industrial nation if she did not correct that fault, if she did not make an effort to take her place—and that an uppermost place—in the world of industry in chemical matters as well as in all others. If the conclusion was come to that it had been by a national fault that we had missed it in the past, and that we were not going to live a disgraced life in future, it meant that that fault must be corrected, and found out for the purpose of avoiding it, and there, he thought, a lesson might be taken from our enemies. To his mind by far the most glorious moment in the history of Prussia was not the moments of her military successes—it was the moment of her deepest disaster. Those who knew Prussian history would remember that after the nation had been prostrated by Napoleon in the Battle of Jena the national independence was utterly taken away. The restrictions the conqueror put upon them were humiliating in

every way. At that time there arose a set of men, of whom he chose to name, first, Fichte, who told the Prussian people in the clearest language that their disaster was due to their national faults, and pointed out the way that they must correct those, and in the most unsparing language he told them that it was only by self-discipline, only by taking to heart their disaster, seeing in it the natural consequence of their national faults, that they could possibly get the resolution or the strength to replace their nation in the position which it ought to occupy. The whole nation listened. It was at that time that the Germans took to physical development and voluntary drilling. They prepared themselves in every possible way for that coming fight which they hoped they would have with their oppressors, and which they had in the course of very few years, but they did it under the exhortations of these men, because they did not attempt to hide from themselves that it was the nation that was to blame for its misfortunes. He was not talking of as grave matters as those of which Fichte spoke, but our position in the industrial world, to maintain for England the glory in peace which it had always esteemed even more than its glory in war, was important enough for us to apply the same lessons as Fichte taught. The fact that our chemical industries were in such a backward state, with certain exceptions of those which needed least thought and least study and least knowledge, was grave enough, if, as he said, it was due to our national faults—it was grave enough for us in these days to rouse ourselves as the Prussians did rather more than one hundred years ago. He was quite sure that if we did do it the same result would come—that we should regain our position, and regain it even with more glory than it possessed before. There was a time when in no industry could England look on other nations as its superior. Now, in the chemical industry — by which he meant mainly the organic chemical industry—it was all but insignificant, and he read with very bitter feelings an address of one of the ablest industrial chemists in the world, the head of the German chemical industry, who was talking about the very subject, and who said: "England talks now of not only holding her own in war, but beating us in our chemical industries. She cannot do it, and that is because the nation is incapable of the moral effort to take up an industry like that —which implies study, which implies concentration, which implies patience, which implies fixing one's eyes on the distant consequences and not considering merely the momentary profit." When he read those words he asked himself, Was that not a fair judgment for a foreigner who could not know the resources of the English people in the way of repentance and resolution and reformation? Was it not fair for that gentleman to say that our behaviour during all these years showed that we were incapable of doing it? And he (the Chairman) would tell them frankly, that if we did not take the lesson to heart at the time of this war, and when the war had passed — when, as we believed, we should have severed ourselves from the military domination of Germany—resolve to save ourselves from industrial domination, all he could say was that the victory of Germany, if not in the form that it would desire, would be quite as great as it could wish.

[Lord Moulton then left the meeting, and the chair was occupied by Dr. W. H. Maw.]

The paper read was—

BRITAIN AND GERMANY IN RELATION TO THE CHEMICAL TRADE.

By William Reginald Ormandy, D.Sc., F.C.S.

The subject which we have to discuss to-night is not by any means a new one. The fact that Germany has slowly but surely been gaining control of the greater part of the chemical industries of the world has been brought home to this country times innumerable during the last forty years. It is true that this control has not extended to the manufacture of what are known as heavy chemicals, where questions as to the cost of raw materials, fuel and freight are of deciding importance. The present unhappy state of Europe, causing a shortage of many drugs and chemicals, has brought this control home in an unmistakable way to the public, who have been made to realise what the manufacturers have known and ignored for at least a generation. Needless to say, there have been many meetings to discuss the situation by those more or less directly affected. The Society of Chemical Industry, both at their headquarters in London and at several branches, have dealt with the matter, and Dr. Mollwo Perkin has recently read a most interesting paper on the "British Artificial Colour Industry" before the Society of British Dyers and Colourists. I labour, therefore, to a certain extent, under disadvantages, particularly as this manuscript had to go to press before I had an opportunity of learning the particular aspect of this important subject to be touched upon in the paper read here last week by Sir William Tilden. From a conversation with Sir William Tilden it was possible to gather that there was bound to be a certain amount of overlapping, but the general feeling seemed to be that the subject was of sufficient importance to justify a little redundancy, which, at the worst, would only serve to emphasise the need for action. Needless to say, numerous committees have been formed

by all sorts of societies and groups of people more or less directly interested. To the lay mind such committees are places where people go to recite speeches, and they naively assume that the speeches are useful and have a purpose. This is quite a usual conception of a committee; many committee men share it. In times of stress such as those through which we are living, it is increasingly difficult to consider such questions as the one before us to-night from a detached and abstract standpoint. Within the bounds of this ancient Society, which has done so much directly and indirectly for science and industry, which has taken the best that could be offered by people of many nationalities, we can at least endeavour to remember that the marvellous and complicated structures of science and industry are international, that in their essence they know no country; that they stand or should stand as one indissoluble link binding all humanity into one great whole. Attempts, and I think foolish attempts, have been made to allocate to various countries the services which they have rendered to this particular aspect of the progress of humanity. It seems to me quite impossible, even if it had any value, to attempt such allocation. Pure science and industry are so interwoven in as far as they make for material progress that they cannot be considered apart. The apparently unimportant pure scientific discovery of to-day becomes the great corner-stone of an industry to-morrow. Those who adapt scientific discoveries to industrial use are as entitled to honour and reward as those who made the original discovery. Just as the progress of pure science is largely limited by the nature and accuracy of the instruments available, so industrial progress is limited by the nature of the machinery available. Those who discovered the spectroscope little thought of the enormous field of investigation to be opened up by it; those who discovered the possibility of making fire and acid resisting vessels of pure silica rendered possible manufactures which the lack of such vessels had hitherto prohibited. The immediate material benefit derivable from the discovery of new means of industrial attack may far outweigh that from theoretical discoveries which have cost infinitely more of attainment. At a recent meeting of the Society of Chemical Industry in London, where some of the views put forward were characterised as puerile in a chemical trade paper, one speaker referred to the futility of looking at the past, as the present was decidedly a time for action. This is a characteristically British attitude. The time for taking action is exactly the time when the closest regard should be paid to the warnings and lessons of the past. The laws of cause and effect which are studied so earnestly in matters scientific, apply with equal certainty to the more complex relations of human economics. A study of the patent literature of this country would be more than sufficient to convince anyone of the reckless manner in which the literature of our own country is neglected. This being the case, it need not surprise us to find that the scientific and technical literature in foreign languages seldom receives consideration.

We will, then, presume to ignore the advice so proffered, and will take a rapid glance over the progress of scientific and industrial development in Germany and at home. It is probable that the laws relating to the influence of environment, which have been proved to be so important in the animal and vegetable world, will be equally applicable to the development of industries, save that influences, such as national temperament, education, and financial relations of a complex nature, have to be brought into consideration. Industrial development on a very large scale was first rendered possible by the introduction of the steam-engine as a power generator and the provision of adequate means of transport. At a period during which this development was taking place here, the rest of Europe was in a sufficiently unsettled state to permit of this country, without serious opposition, becoming the workshop of the world. No finesse was required to sell the output of our mills and our ironworks. America, like a healthy growing child, had an inconceivable appetite for all those finished and intermediate products which could only be produced by a nation whose industries had been slowly developed and well established. In those days the English manufacturers, who paid low wages, and exacted long hours, made enormous profits. The experimenting which had to be done to develop the various industries was of a rule-of-thumb character and essentially non-scientific in its nature. Probably no nation is so well fitted as the Anglo-Saxon race to develop rapidly along such lines. As a race our people are practically inclined, and so long as development required nothing more than the close application of a healthy common-sense, progress was astonishingly rapid. A very old man, whose family was one of the earliest to take up the manufacture of cast steel in this country, has told me that in the early days of the firm's history it was no uncommon thing to receive orders for

tons of steel required for the manufacture of drills and tools to open up the virgin wealth of America, in which not only was no price mentioned, but it was explicitly stated that within the bounds of reason quick delivery would compensate for any price. The products of our boiler yards were famed throughout the world, and incredible profits were made by firms whose successors have found the competition of recent years more than they could support. This was, of course, due to the fact that in the days of prosperity the profits were divided to the last penny, the machinery was allowed to get out of date, and the working people refused any longer to play the part assigned to them by the manufacturer in his profit-making schemes. Dr. Mollwo Perkin has probably given the correct explanation for this pronounced tendency of British manufacturers to starve and bleed their own business. The rapid industrial development of foreign countries called for enormous capital for railways, shipping, docks and harbours, and the opening up of mining and agricultural properties, and it was felt that a better return could be obtained from such ventures. English spinners and weavers were supplying the whole world with their products, while loom and mule machinery makers were working day and night to supply these foreign purchasers with the machinery for their infant industries which were in future years to compete with the home country for their own and neutral markets. For close upon 100 years the tide flowed in our favour. There was no necessity to practice economy. Nature had been lavish with our raw materials, our insular position and the proximity of our manufacturing centres to the sea-board gave us natural advantages which, added to a favourable situation in international relations, rendered the growth of our material success inevitable. To the thinking mind, it was obvious that such a concatenation of favourable circumstances could not continue indefinitely. We provided other countries, at great profit to ourselves, with all the means necessary for competing with us in those markets in which we had hitherto enjoyed a practical monopoly. Our own works were frequently equipped with out-of-date machinery, which was busily employed in making more modern plant which was put into the hands of those who realised that they would have to exert their powers to the utmost if they were to gain a fair share in the barter of the great international bazaar. The British industry of to-day is in the position of a son inheriting an established business, and having in addition a very large income derived from the labours of past generations. Properly used, such a situation should make for enhanced prosperity; but even such powerful advantages may be nullified if the effort to work along the lines which proved successful in our grandfathers' days are continued too long. Capital directed by ignorance and apathy cannot hope to compete for ever against the forces which are brought to bear to-day.

The industrial life of Germany may be said to have commenced little more than a generation ago. To all intents and purposes an inland country, with little sea-board, they were under a huge disadvantage in every department which required raw materials obtained from abroad. In many directions their natural resources were comparatively poor. They had no iron ores which were comparable with the hematites of Cumberland, their limestone was largely dolomitic, their coals were for the most part poor in quality, and lay often in distorted seams, more like those of our Bristol coalfields than the comparatively easily-worked deposits in our northern area. It was recognised at an early period in their industrial development that national progress in a country situated as was their own could not be left entirely to individualistic effort. Nationalisation of railways and canals became an obvious necessity if differential traffic rates were to be allowed, and differential rates were an absolute necessity if large industries were to be developed in the interior of Germany far from the sea-board. Too much credit cannot be given to the far-sighted way in which every problem of agriculture and industry in Germany is regarded from a national standpoint. It is realised by everyone that individuality must be, to a certain extent, fettered for the benefit of the nation as a whole. In this country individuality runs rampant, and except in times of stress, such as those through which we are passing, the national or Imperial bearing of any individualistic action receives not the slightest consideration. The very people whose fathers sold land to the railway companies at absurdly inflated prices now complain that, owing to the high railway freights in this country they cannot make adequate profits from the investment of the money obtained from those same companies by an earlier extortion. No doubt many of those who have made their profits from such action would like to see the English railways nationalised and freights reduced at the expense of that patient beast of burden, the British

public. Whereas Germany is continuously developing her network of waterways, we in this country, with a customary lack of national forethought, allowed our waterways to become controlled by the railway companies.

Having thus settled the enormously important question of transport, Germany had to consider the lines along which she should seek for an expression of her industrial destiny. Agriculture, there as here the largest individual industry, received attention which is as striking as is the lack of it in this country. Proper afforestation schemes were rendered compulsory; enormous areas of land fit for little else were put under potato cultivation, and science was called in to help to create a new outlet for the crops. Germany became essentially the starch, glucose, and alcohol producing country of Europe. Other large areas were used for the cultivation of the beet, and once again science was called in to assist in the disposal of the roots as raw materials for the production of sugar. If the manufacturing of iron had to become a great industry it was necessary to develop economic methods for the utilisation of the great deposits of low grade phosphatic iron ores which were those chiefly available. In addition to the home deposits of iron ore large amounts have been imported, but how successfully the problem has been tackled is shown when we consider that twenty years ago the German production of iron was a mere fraction of our own, whereas to-day the German output exceeds the British by nearly 100 per cent. The problem of working up the complex metallic ores has fallen almost entirely into German hands. They alone were willing to spend the time and money necessary on researches pertaining thereto, and they alone seemed willing to devote that close chemical skill and attention which is necessary in dealing with these complex problems. In the early days of the chemical industry it must have been quite evident that Germany could not hope to compete in those branches of heavy chemicals such as soda ash, caustic soda, sulphuric acid, bi-chromate of soda, alum, etc., where cheap raw materials, freights, and cheap fuel play a greater *rôle* than chemical skill and complex machinery. There is, however, not the slightest doubt that Germany realised years ago what this country has not yet grasped—namely, that all industrial development tends to become more and more scientific. The adequate utilisation of the by-products from an industry may settle the question of the survival of the industry itself.

The necessity for broad co-operation in great industrial problems was recognised and acted upon in Germany in a hundred directions. By-product recovery coke ovens were installed in the immediate neighbourhood of the blast furnaces, and the surplus gas from both was used for power generation. The steel works were erected in the immediate vicinity of the blast furnaces, so that the surplus power might have an economic outlet. Where it was impossible to bring the steelworks to the vicinity of the coke ovens and the blast furnaces, the surplus energy from these was transmitted far and wide in the form of high-tension electric current sold at an astonishingly low price and thus tempting to the introduction of new small industries within the immediate area. The by-product recovery coke ovens were required to another end. Slowly but surely Germany had been developing her fine chemical industries, drugs, and dyes. Many of these manufactures were dependent for their raw materials on products only obtainable in quantity from this country. We have been building up an enormous industry, not only in the spinning and weaving of cotton and woollen yarns and fabrics, but a correspondingly great industry in the bleaching, dyeing, and finishing of these products. This has been chiefly developed on dyes obtained from Germany, but while we have been content to leave ourselves entirely in the hands of others, the Germans have, by the exercise of scientific skill and a sensible use of capital, rendered themselves independent of this country. German capital was spent like water to foster the development of by-product coke ovens and in the development of the allied fireclay trade for the production of suitable apparatus, to the end that fifteen years ago practically the whole of the hard coke produced in that country was made to give up its toll of by-products which were the raw materials for their great chemical industry. It was in Germany that the preliminary treatment of low-grade coal to render it fitted for the manufacture of a suitable blast furnace coke had its origin and development, and only in the last few years have our colliery companies recognised the value of adequate sorting and washing plant in connection with their output.

The history of the growth of the phosphatic manure trade was a striking lesson in German adaptability, but the time at our disposal will only permit of attention being called to it.

In the whole history of human development, perhaps no trade has varied less in its methods

than that of the potter, and so long as this manufacture depended primarily on the proper utilisation of raw materials as found in Nature and great personal skill on the part of the work-people, so long did this country control the industry. Favoured to an extraordinary degree by Nature in the provision of the necessary raw materials, our work-people developed an almost unnatural skill for the production of beautiful objects under the most adverse conditions and with the most primitive mechanical help. The discovery of the possibility of casting complex forms and the growth of the electric industry with its great demand for porcelains of high insulating capacity, opened the door to German competition, until, before the war, it could be said that the world's demand for electrical porcelain was practically met by Germany alone. The sanitary ware trade has been for many years, in Europe, an English monopoly, probably largely owing to the lack of suitable raw materials in other countries, but by an expenditure of hundreds of thousands of pounds this situation has been changed, and had Germany, at the command of its military dictators, not entered upon this war, I am confident that the control of this industry would have fallen into German hands in the very immediate future.

At the recent meeting of the Society of Chemical Industry above referred to, Professor Henderson referred to the chemical industries of Germany as being merely the development of the crumbs from the British loaf with which they had had to content themselves. In so far as the metallurgical industries are of necessity chemical industries, the term crumb, as applied to an iron and steel trade much greater than our own, seems out of place, and the remark is only another unfortunate example of the willingness that exists in many quarters to pander to an already too strongly developed feeling of national self-esteem. The British as a nation never show up so favourably as when they are placed face to face with difficulty. As a race we have so much of which we can be genuinely proud that it is a little less than treason when those to whom the people should look for guidance and warning feed them with fulsome flattery and lull them to continued sleep with mental opiates. In ever-increasing degree, both in this country and Germany, the population are dependent on industries for their livelihood. Both countries have long passed the stage at which their home market is capable of keeping the industrial machine in full activity. In addition to each being the other's largest customer, both have to look to the rest of the developed parts of the world for an additional outlet. Someone has said that a nation gets the newspapers it deserves. Judging by what has appeared in some portions of the daily press during recent months upon the subject of German trade, it is devoutly to be hoped that the common-sense of the British nation will not be judged thereby. During the past ten years a nation of over sixty millions has been increasingly occupied in industrial operations. Our own smaller population has, on the whole, been equally fully employed during the same period, and yet people write as though there was a possibility that a large proportion of the activities of the larger nation could be profitably undertaken in a small country whose work-people have been for the most part well and profitably employed for the last decade. The absurdity of this requires no refutation. Indignation is expressed at the discovery that German people and German capital are by way of controlling an ever-growing number of industries in this country. I have not seen that any serious attempt has been made to the much more serious end of discovering why the Germans should desire or should be able to get such a foothold in this country. In some few instances I could supply an answer from my own experience. We have already seen how the German Government bring science and agriculture to work together in afforestation, and the cultivation and utilisation of potatoes and beetroots, but throughout the German national history the government have recognised that, as a people, they are in ever-growing degree forced to live on industry, and that modern industry is built on the hand-in-hand co-operation of science and capital. This country is dependent upon industrial development for its very existence in a higher degree than Germany, and yet so far as governmental assistance or interest is concerned the principal occupation of the British people might be the signing of dividend coupons. The German government is incomparably poorer than our own, and yet the financial assistance which they render to technical education is immeasurably greater. The standard of general education is undoubtedly higher, no doubt largely in consequence of the temptation offered by their one-year service system in the army to those who have passed a certain high standard of efficiency. In a land where the standard of payment is, on the whole, much lower than our own, the leading men of German technical schools are far better

paid than in this country. The heads of the technical school staffs are encouraged to become acquainted with the latest technical progress. It is fully realised that a purely academic teacher cannot turn out first-class technical men. The technical industries instantly claim, at higher salary, the members of the staff of technical colleges who have carried out original investigations which seem likely to open out industrial possibilities, and it is not an uncommon thing for such a man to be reclaimed by some technical institution at a later date at a still higher salary. It is realised that the right man, who has works experience as well as technical knowledge, is worth far more to the nation as a teacher than in a private capacity. If an industry requires to make use of ingredients such as alcohol and ether, which are under excise control, the government will go to the greatest trouble to arrange matters in such wise that no needless restraint is imposed. That the staff of a government department should interpret a government order in an unduly restrictive sense, so that an industry might thereby be hampered, is there inconceivable. Only in Great Britain and Turkey are government restrictions allowed to be interpreted at the will of the permanent officials. I do not for one moment wish to imply that I consider that the question of industrial alcohol has been of the main, or even of serious import, compared with others, in our neglect of the fine chemical industries. I quote it rather as an example of the contemptuous attitude which our government has hitherto adopted towards matters industrial. In certain branches of the chemical trade it is essential to have the chemically-pure alcohols and ethers, but the would-be manufacturer is told, by the Government, in effect, that he is not to be a judge of what is necessary, but that the question will be settled by some heaven-sent genius in their permanent employ who, like the journalist on a halfpenny paper, knows more about the subject than the man who has made it a life's work.

A feature of the German industries is their willingness and ability to work in co-operation, as is shown in many ways which are no doubt familiar to most of you, but with which we have not time to deal. With all the help which a favourably-inclined government could render, the German industries would have been unable to approach their present standard of efficiency had it not been for the remarkable co-operation which takes place between science and capital. This can perhaps be best illustrated by means of some concrete examples. Let us suppose that some chemist in Germany has discovered a new and cheaper method for making some chemical product which is in considerable demand, or which might become a large article of manufacture if the price were sufficiently low. If the manufacture is likely to require a considerable capital the inventor would probably go to one of the large banks. The German banks permanently retain the services of some of the leading authorities on a wide range of subjects and the inventor would be asked to put all his case before the particular expert in charge of his department. If the report were of a sufficiently satisfactory nature on the scientific side, the bank would proceed to make their own inquiries, through the many channels open to them, as to the probable outlet for the new product. If the outlook were in all respects sufficiently satisfactory, they would advance the necessary capital at a reasonable rate of interest, making certain stipulations such as that the business should be carried through their bank; that payment for the finished products should be made through the bank; that no contract for the sale of the finished product should be made with any firm without their consent. The bank having much greater facilities for gauging the financial standing of the purchasing public, in this wise protect their own interests and that of the inventor. We have presumed a case in which the investor has a process which is worked out to commercial finality, and capable of being demonstrated to an adequate extent on an experimental scale, but the activities of the German banks do not by any means cease at this point. An inventor may have made certain discoveries in a new, or recondite field of work which, on the small scale, or with the facilities at the disposal of the inventor, cannot be demonstrated commercially, It may only be possible to show that with the expenditure of considerable capital and much labour and time can great results be expected. If the new discovery adumbrates great commercial possibilities, such as the development of a new industry, or means for obtaining control of an existing one, then the banks are willing to give assistance on very reasonable terms.

Naturally, in the latter case the bank makes the most stringent investigation by means of their own experts and by calling in the aid of any of those likely to be best qualified to help in coming to a decision as to the probable economic value of the principles foreshadowed by the new work. The committee of experts

may say that what has been put before them is a new invention; that it seems to open up possibilities that by its help certain great industries of worldwide importance, at present carried on by slow and expensive means, may be entirely revolutionised, and that which took days may be done in minutes, or that which employed expensive materials may eventually be done by employing cheap residual products. They may admit quite candidly that, although all this is likely, it is none the less problematical; but still, in their opinion, a few years' work, and the expenditure of £50,000 or £100,000, will, highly probably, place the owners in a situation which will enable them to exact very great returns for their outlay. The writer knows of a very apposite case where a company has been formed with a capital of nearly half a million sterling to develop certain inventions which in many directions were very embryonic. Practically the whole of this money has been provided by private and other banks, who realise that quite a number of years may elapse before an adequate return is gained, but they also realise that, so far as human skill and knowledge can foresee, a few years will place them in a position to control several of the world's greatest industries, in which case their return will be of a very high order.

Again, nothing is more startling to the Englishman than the ease with which one can gain admission to those in command of the great industries. The directors of the German companies, for the most part, and the managing director invariably, are men of high technical skill in the business they control. The idea of putting a stockbroker or a retired army colonel at the head of a scientific industrial concern would be regarded as an act of madness. Not only are German businesses run by men who understand them, but these industrial leaders have always time to give adequate consideration to any new proposal which is brought before them. It would be the exception rather than the rule to find directors in an English company who were capable of appreciating, still less of judging, the merit of a technical point relating to their own business. It would be almost an impossibility for an unknown outsider to obtain admission to such directors, and even if the unknown inventor succeeded in getting within the veil which hides the holy of holies, it would probably be to find that the master-mind had so many appointments that he never by any chance had time enough to consider any proposal thoroughly. The heads of a German concern have always time to look thoroughly into anything which interests them; they are sufficiently technical to realise the necessity for going into details, a works' experience having taught them that it is on details that great processes come to grief. In spite of their intellectual and commercial attainments, however, these directors are, in some respects, both modest and unassuming. They still think that success can be purchased only at the cost of labour; they are content to work from 8.30 to 6.30, with two hours' pause in the middle of the day, and they work full six days to the week. No doubt they envy, but they do not lay claim to, that super-type of intellect which, labouring hard from eleven till four with an interval for rest, sometimes even five days a week, expects, not only to retain its old position, but to dispossess its competitors; they even learn foreign languages so that they may profit by the knowledge gained by other people in other countries.

Let us suppose for one moment that it was Germany that was short of drugs, photographic chemicals and dyes, and that England had possessed a monopoly in these products. Further, we will suppose that the joint general manager and head chemist of one of the large English drug and photographic chemical works had found himself in Germany at this period, with sufficient acquaintances in that country, men with whom he had for many years made large contracts and who were fully cognisant of his scientific and technical ability to guarantee his claims. He could go to any bank and say, "I can show you how to make a number of photographic chemicals and drugs even more cheaply than they can be made in the country which has hitherto controlled the manufacture, because you have the necessary raw materials, because you have, indeed, previously sold these raw materials to the previous makers. I bring you the necessary evidence that these products can be made at half the sales price obtaining before the war, and I can demonstrate that the sale in your own and neutral countries of these products amounts to some thousands of tons per annum, and that, under normal circumstances, after the war is over, it will be impossible for your business to be displaced by undercutting. Finally, I will bring you reputable dealers who will make contracts for hundreds of tons of these products at prices which will pay for the plant and show profits in one year's working." The bank would confirm these statements through their experts, and probably

within forty-eight hours all the money that was required would be available at 7½ per cent. The man who possessed the scientific, technical, and commercial knowledge would thus be enabled to build up a business which would be profitable to himself and valuable to the community, the fact being that it is recognised in Germany that capital is entitled to a fair return and nothing more.

Now let us imagine that circumstances were reversed. It would require the pencil of a Hassall adequately to depict the scene in the board-room of an English bank where such a proposal had been made. One can imagine the possessor of such knowledge offering it to existing chemical works. Being presumably a travelled and educated individual he would realise that our so-called chemical works were, for the most part, of the tub and stick order—that is to say, that the bulk of their business consisted in acting as agent for German and other firms, and for the rest, recrystallising products or mixing up weed-destroyers. He would discover, if he ever got a hearing, that the larger chemical works, cognisant of the mental attitude of the financial classes in their own country, would either refuse to put forward the necessary capital or would offer to undertake the manufactures on utterly impossible terms. Everywhere he would make the, to him, astonishing discovery that no one realised the possibilities of the industries which he wished to develop. Drugs and photographic chemicals were sold in ounce bottles. If he endeavoured to prove that the total trade in photographic developers was in the thousands of tons per annum he would be met by polite incredulity. Eventually we may suppose that our hero decides to test his fortunes in that great hub of cash, intellect, and roguery—London. Guided by past experience he would probably manufacture a few of the products under the observing eye of the finest independent expert he could learn of, in a country practically ignorant of the industry which he represented, and he would obtain from men of standing the offer of contracts for tons of the materials he proposed to manufacture showing very great profits. If a stranger to the city, the odds are a hundred to one that he would fall into the grasp of some plausible tout of a third-rate company promoter, in which case, unless we are in for the second edition of a thirty years' war, his chances of arriving at any finality are practically nil. The best that he could hope for would be to become a tied servant of a heavily watered company, short of working capital, loaded down with preliminary expenses, weighted with directors and a staff, not only ignorant but careless as to the future of the concern. The amount that he himself might hope to receive from this last and greatest evidence of twentieth-century progress, a city company promotion, would be little else than paper. He would learn that the cash consideration exacted from the British public on the strength of a prospectus backed by guinea-pig directors was required, as to the greater part, to pay commissions to a long train of intermediate parasites who live in this wise on the spoliation of industry.

If by a miracle he succeeded in escaping the clutches of the type above described and was brought into direct touch with real capitalists, he would learn in a practical way the immense respect exacted by English capital, and would be astonished to find that as a representative of creative and productive industry he was to be treated as a lower organism which should be devoutly thankful for being allowed to commune with less intellectual, but socially enormously superior beings. He would find that these worthy representatives of the golden calf had no time to go into details. Having assured themselves that there really were considerable prospects of large financial returns, the last thing they desire is to permit the inventor to put himself in a position to demonstrate the full value of what he is selling.

Whatever certainty attaches to the processes of which he is a master, he must be made to feel that they are nothing more than a vast experiment. Having a positive contract, let us say, for forty tons of a special product showing profits of 3*s*. per lb., and having demonstrated by means of an independent expert appointed by themselves that he can make this product at something like 1*s*. per lb., they will probably offer to find him a very inadequate capital, for which they will require a stiff cumulative preference interest and the bulk of the profits remaining beyond that. In his own country, where salaries ruled lower, he would have received at least double the salary that he will now be offered. No doubt the wanderer from another country would think these terms sufficiently onerous as they stood, but he has yet to learn that in a hundred and one ways his diminished rest of the profits had to run the gauntlet. At the wisdom of the directors other chemists can be put in over his head. For what is a man a director if not to find comfortable berths for striving relatives? The men of gold will employ

a learned advocate, who will draw them up memorandum and articles of association most cunningly worded, whereby, should the occasion warrant it, they can issue shares at a discount, or bring out new classes of shares having prior rights; where they can, in effect, render it practically impossible for any serious proportion of the profits to wander in undesirable directions. Should the inventor have the temerity to suggest that such terms would be hard if applied even to untried inventions which had still to live through that development period where childhood's diseases are active, recourse would be had to the awful effects of example. The ocean of commercial history is foul with the carcasses of dead and gone companies for exploiting chemical and quasi-chemical inventions, and one or more of these would be gibbeted for his benefit. Of course, he would not be given time, even if he had the necessary knowledge, to find out whether the company in question failed because the process was intrinsically bad, or whether, which is much more likely, it perished from that frequent disease of modern limited companies—water on the brain, or rather water in the shares. In my humble opinion the modern company law, with its attendant train of parasitical followers, is more responsible than anything else for the failure of scientific industries to advance in this country. The longer I am acquainted with the men who are something in the City, the greater is my respect for the workers of the North. Just before the war broke out I had almost completed negotiations whereby it would have been possible to introduce selected British inventions to a powerful group of German capitalists. It had long been obvious that it was a waste of time and energy to endeavour to get these, even intelligently, considered by English manufacturers or English capitalists. It proved possible to do more business in this direction in one week in Germany than in this country in a year. In many cases the German capitalists insisted upon having the right to acquire the English patent along with the German. They knew that England was a great market and much the finest centre for building up an export trade, they also knew from past experience how small were the chances that they would have to meet any competition in this country. They had found, from past experience, that it was useless offering their own inventions on this side of the water, and in a large and ever-growing number of cases, convinced of the great value of the processes they were exploiting, they actually bought controlling interests in English companies in order to be in a position to force these to take up new methods which were vital to the progress of the industry in question. If a German discovers a new method for increasing the yield and cheapening the cost of a chemical substance which is an intermediate product in the manufacture of other intermediate products eventually used in dye-making, we cannot take on the manufactures ourselves, for it is valueless. Our chemical works are so far undeveloped in certain directions that they have no use for such a product. It is about as useful as an improved watch escapement would be to an Esquimaux. If the German starts a work in this country for making this and other products, or if he purchases a controlling interest in a firm with the object of compelling its manufacture we complain of German dominance in our industry. The German commercial man was likened in this room to a burglar, and this because he visits our manufacturers in the middle of the day and finds them asleep. Modern commerce is warfare, and the weapons employed are—inventions, tireless industry, skill, and capital. We make the mistake of putting the last first. Those who do research and make inventions, whether in chemistry, engineering, or any other branch, are the yeasts which leaven the whole mass, but in this country we do not allow those conditions of warmth which permit the yeast to work. Gold in itself is not nearly so valuable a metal as iron, and we are slowly but surely finding out that capital itself is an over-valued possession if it be not used for the benefit of the industries and consequently of the nation as a whole Our men at the front in defence of British honour and British security are risking their lives, but the English capitalist has no desire to risk anything. Having, through his own sloth and apathy, through his unwillingness to look ahead, through the inability born of ignorance to appreciate the right use of science, fallen behind in the race he now desires protection. He would persuade the British people that representative government means government of the people, by the people, for the benefit of the—manufacturer. He is a veritable dog in the manger. He refuses to take up new processes or to apply new methods, and objects still more when others, with greater enterprise, seize the opportunity. If the greatest war, if the greatest opportunity this Empire will ever know will not move him to action, I am not so conceited as to imagine that any dialectic weapon which I can wield will be sharp enough to penetrate his hide-bound self-complacency, still less the triple brass of his imagined self-interest.

DISCUSSION.

Sir William A. Tilden, D.Sc., F.R.S., in opening the discussion, said he had listened with mixed feelings not only to the paper but to Lord Moulton's remarks. He could not help hoping most sincerely that the words which had been used by so eminent a person as Lord Moulton would find an echo in those regions inhabited by the leaders of British industry; for it appeared to him that unless a good many of them first of all were brought to acknowledge their position of humiliation, and secondly, determined that if they were too old themselves to learn, at any rate their sons and successors should be taught what was necessary in the way of scientific instruction connected with their own businesses, then it was all over with British industry. He must say out of his own experience, living as he had for fourteen years in a great industrial centre, that many of the author's pungent remarks were really not exaggerated. He used to see, with great regret, young men driving to business in the morning at eleven o'clock when the works had been going from six o'clock. In many works which he had visited he invariably was amazed at the extraordinary ignorance displayed on the part of the partners themselves in the operations which they were supposed to conduct in their businesses. Over and over again he had been in works in the Black Country, and his friend, the director or manager, was exceedingly anxious to show him anything, but if he asked any question about details the manager or director could not answer them, but sent down the yard for "old Tom" or "old George," who was the only person in the place who seemed to know how the process could be conducted. He did not believe that the serious character of the question of education had yet been completely realised by the present industrial directors and leaders, and he could not help thinking that that was one of the most important considerations to be taken into account at the present time—that the young men who were to be the manufacturers of the future should have a very different kind of career from that which had been hitherto prevalent.

Dr. M. O. Forster, F.R.S., said, whilst fully agreeing with the author in his castigations of the manufacturer and the Government, yet he did think that while chemists were so busy in casting motes from other people's eyes, there was one beam in their own which certainly should be removed forthwith, and he thought the present opportunity was the right occasion to remove it. They had too long allowed confusion in the public mind as to what really chemistry was, and what chemists did. It was perfectly ridiculous that any attempt whatever should be made to capture German trade while the general public had not the faintest idea of the difference between the chemist and a druggist. He referred to an advertisement published in a well-known evening paper a short time ago, in which a certain firm of chemists advertised that they had 800 chemists in their employ. It was a ridiculous statement to make; yet, as the law at present stood, it was perfectly true. At the present time the only people who were entitled to call themselves chemists were those who had undergone a course of training at the Pharmaceutical Society or who had passed examinations conducted by that body. In fact, he believed, of all the chemists, so-called, present that evening, only Sir William Tilden was entitled to call himself a chemist by law. Only the previous Sunday a distinguished literary man had said to him, while they were discussing the question of capturing the German chemical trade, "Oh, but Blank's, the chemists, are going to make all these things"; and, again, in the hall of one of the City companies, while discussing the matter, a distinguished architect with educated sons, had asked him to tell him the difference between a chemist and a druggist. It might be asked what bearing had such facts upon the question of the chemical industry. It was that so long as the average educated man with educated sons, whom that man intended to put out into the world, had not the faintest idea what chemistry was, and what chemists did, and who, moreover, had lurking at the back of his mind a suspicion that a chemist only occupied his time in selling sponges and tooth brushes, so long would that man refrain from putting his sons into the chemical industry as a profession. In Germany and France chemists and druggists were clearly defined. He believed that if Lord Moulton were interested sufficiently in the matter to approach the Pharmaceutical Society, and pharmacists in general, at the present time of national stress when all classes were making sacrifices, that they would agree that only those engaged as chemists in the chemical industry should use the name of chemists. If Lord Moulton would do that, and succeed in that object, then he would go down to posterity as the godfather of British chemistry, because he would have given chemists their name.

Dr. Rudolph Messel, F.R.S., thought it had clearly emerged that we as a nation had been, so far as new chemical industries were concerned, as blind as a taxicab driver when he looked for a fare and quite overlooked the man who was hailing him. We had everything ready at our hand. At one time there was a great deal of grumbling about education in science. He had been in England for forty-five years, and he could well speak about the enormous progress which had been made in this country as far as chemistry was concerned. There was talent enough, capital enough, raw material—everything. But what was lacking was enterprise. If the talent which was now available in this country was utilised, the industry could do just as well here as in Germany. He had to give one word of warning in

establishing new industries—first of all to be sure that we only took up those industries which we were prepared to defend when war was over.

Dr. F. G. Ogilvie, C.B., said it had occurred to him, while listening to the paper, that the deplorable condition to which the author had drawn attention was not at all peculiar to the chemical industry; it had been observable in a great many other industries. Each had its own special conditions, but there was one condition which was general, and to which he desired to draw attention. There had been a tendency in connection with many individual industries for the divorce of the control of capital from the knowledge and experience required to apply capital effectively. The influence which produced this tendency was partly a social one, and it was one which he was very hopeful the war might do a great deal to correct. It arose in the following way—he looked at it from the observation of two generations of young men, his own contemporaries, and those who were a generation younger than he himself was—a man had done very well, say, in the manufacture of tweeds in a centre where a large tweed industry was going on. His family found themselves very well to do, and were attracted, as young men, much more to field sports, county meetings and things of that sort than they were to the serious study of their own particular business. The net result was, when they came into power they had to work the business not perhaps entirely by "old George" or "old Tom," but by managers, often underpaid and undertrained, who naturally, even when they proved themselves very good men, had not the ready access to the application of capital year in and year out which was necessary to keep the business up to date. He knew many cases where that had influenced seriously whole regions of trade. It had not happened where the sons had followed in the footsteps of their fathers, but had added scientific training to practical experience in the works. In that case there were good, solid, steady-going businesses which were introducing new products just as fast as could be wished. He trusted that the increasing attention which was being given to the serious aspects of life at the present time would prove permanent, and that it might influence this particular aspect of the matter.

Mr. Adair Roberts desired to address a few words to the young men present that evening. Many of the businesses which it was now sought to capture from Germany could be started with very little capital, and a young man could very well start one of such industries in a small way and enlarge it as time went on if he brought his business, as well as his chemical, ability to bear on the subject.

Mr. Walter F. Reid said, at the previous week's discussion, he had ventured to put the question of capital first in the matter, and he again did so on the present occasion. He thought it was quite impossible to suggest that a young chemist, just out of a college or university, could get a large salary unless he showed himself to be worth it. An employer would not look at him as a professor, but as a beginner from the industrial point of view. In fact, he was an apprentice, and if he was not willing to take the salary of an apprentice at the beginning he could not grumble at the capitalist, who opened up to him a very good future of great promise. With regard to some of the industries which this country had lost, he would refer to the glass industry. His own opinion was that we had lost that industry chiefly through the unwillingness of the workers in the trade to allow apprentices in sufficient number. After the production of capital, the next important point was the security of it. He could not put the matter more clearly than it was put by the Institute of Chemistry, which said: "Provided that the manufacturers could be afforded some guarantee of permanency for their enterprise, and that they may have some reasonable assurance that at the conclusion of the war the newly-developed industry will not suffer from foreign competition, hitherto made possible by economic conditions which do not prevail in this country." Dr. Messel had said exactly the same thing. If the capital which would have to be invested in new and expensive plant and in the payment of research workers and other workers could not be secured, then the capitalist could not be blamed for not coming forward. Our workmen and capitalists must be given the same protection as Germany gave to theirs. Our German competitors could then be met on equal terms, and he was not afraid in the least what Englishmen would do then.

The Author, in reply said the object of his paper was that it should form a stone to make some ripples in what he thought had been a pool of complacency, and he thought it had fairly performed its object. The only question which had been raised, which he thought was of serious import, was that with regard to the industries to be taken up. He agreed absolutely with Dr. Messel: We must be most careful in taking up only those industries where we were at least on as good a footing as the Germans were with regard to raw material. With reference to workmen, he had not the slightest doubt that English workmen were better than any other workmen on the face of the earth. He had watched German, French and Belgian workmen, and he thought the English workman was more reliable and could do more work in a day than any other. But up to the present neither the English workman nor the English chemist had been given half a chance to handle modern scientific processes. It was the opportunity to let each of them prove what they could do that had been lacking, and if

we kept our attention fixed to those things where we had the necessary raw material, there was no question about the future, because we would have our own country and all the neutral countries and all our colonies at least, as a market, and surely that was a big enough one.

THE CHAIRMAN (Dr. Maw), in proposing a hearty vote of thanks to the lecturer for his interesting paper, said that personally he had not had any intimate connection with the chemical industry, but he was sufficiently old to remember that the state of affairs which the author had described as existing in that industry also existed in past times in many other industries. He was glad to say that in the case of the engineering trades and iron and steel manufactures the last twenty years had seen a very remarkable advance in the recognition of the value of scientific research, and he hoped the same advance would take place in the chemical industry. Some of the statements which had been made by Dr. Ormandy reminded him of a story which he had heard of the experience of the late Dr. Elger when he was appointed, many years ago, to the Chair of Naval Architecture at Glasgow University. Dr. Elger had thought it desirable to ascertain to what extent scientific research was being carried out at the chief shipbuilding establishments on the Clyde, and he found the results of his inquiries to be very varied. At some places much important work was being done, and at others the commercial value of scientific inquiry was practically ignored. In one instance, when he was informed that a scientific department existed he ventured to ask the head of the firm if he found the work of the department remunerative, and, receiving a reply more or less in the affirmative, he further asked if he might be told how much was spent on the department. The reply was that "he" had hitherto had "sax and twenty shillings the week," but that "he had now got a rise of two shillings"! This was many years ago, and the state of affairs was now very different.

The vote of thanks to the author for his interesting paper was put and carried with acclamation.

THE COTTON INDUSTRY OF THE LEEWARD ISLANDS COLONY.*

In this paper the history of the development of the industry of the cultivation of Sea Island cotton in the Leeward Islands Colony of the British West Indies is traced.

An account is given of the conditions under which the staple is produced in the different Presidencies of the Colony.

The methods adopted to foster the growth of the industry are described, and the manner in which development has occurred is illustrated by statistics giving the detailed exports for each year since the inception of the industry.

The cultural methods in vogue are dealt with and also the means adopted to secure the maintenance and improvement of the staple by means of plant selection: this side of the work has for a number of years past constituted a very important branch of the activities of the Agricultural Department.

The principal insect and fungoid diseases to which the crop is liable are enumerated and the means adopted for their control indicated.

In the concluding sections of the paper the conditions under which the industry is carried on in each of the islands in which Sea Island cotton is grown are summarised in some detail, while finally a general review is given of conditions affecting the stability of the industry and its future prospects.

The natural conditions obtaining in many of the islands are well adapted to the cultivation of Sea Island cotton.

The industry dates from the year 1902, and at present is carried on in Antigua, Barbuda, St. Kitts, Nevis, Anguilla, Montserrat, and the Virgin Islands. It is conducted both as an estates crop and also as a peasant industry.

Development has been assisted by the Government through the medium of the Agricultural Department and by the British Cotton Growing Association. The assistance rendered has taken the form of grants in aid of purchase of machinery, of skilled advice on the treatment of the crop, and of the provision of market facilities.

The soils on which the crop is grown include a very large variety of types ranging fron non-calcareous volcanic sandy loams and loams to highly calcareous soils.

The annual rainfall in the cotton-growing districts ranges from 30 to 70 ins.

The total area at present under cultivation is estimated to range from 8,000 to 10,000 acres annually.

The total exports from the Colony for each year since the development of the industry are given in summarised form below:—

Year.	Exports of lint in lbs.	Year.	Exports of lint in lbs.
1902–3	50,480	1908–9	697,423
1903–4	152,160	1909–10	690,154
1904–5	382,477	1910–11	1,371,307
1905–6	526,382	1911–12	1,078,794
1906–7	702,910	1912–13	1,149,189
1907–8	1,127,126		

* Abstract of a paper read by H. A. Tempany, B.Sc., F.I.C., F.C.S., Superintendent of Agriculture for the Leeward Islands, at the Third International Congress of Tropical Agriculture, London, 1914.

At an assumed value of 1*s*. 6*d*. per lb. for lint it will be seen that during the past three years the value of the exports has ranged between £75,000 and £100,000 per annum, while the total value of the exports for the entire period during which the product has been cultivated exceeds £500,000 in value.

The importance of maintaining the quality of the strains of seed cultivated is very great. Seed of high quality was introduced into the Colony from the Sea Islands of South Carolina in 1904 through the agency of Sir D. Morris, then Commissioner of Agriculture for the West Indies; this has formed the starting-point from which the majority of the strains at present cultivated have been derived. At the present time large-scale selection work is carried out by the Agricultural Department in every Presidency, and many of the strains of seed thus originated have found their way into general cultivation.

For its successful production the crop requires high cultivation, and in this respect the level maintained is, in practically all cases, satisfactory. Hand labour is very largely employed.

Experience has shown that each island tends to develop a type of lint characteristic of itself as the result of local soil and climatic conditions; this fact is of great importance in relation to the origin of strains of seed to be planted each year.

The principal insect pests to which the crop is subject are the Cotton Worm (*Alabama argillacea*), Leaf Blister Mite (*Eriophies gossypii*), Cotton Stainers (*Dysdercus* spp.), and the Flower-bud Maggot (*Contarinia gossypii*), the last only having proved a pest of serious importance in Antigua up to the present. Among fungoid pests must be classed Anthracnose, Angular leaf spot, and a bacterial boll rot. On the whole the insect pests must be regarded as of more importance than those of fungoid origin. In the majority of cases the various diseases and the methods of control are well understood.

Regarding the conditions under which the industry is conducted in the different islands, in Antigua the crop is grown both as a main crop and as a rotation crop with sugar; there is also a certain amount of peasant-grown cotton. The industry experienced a considerable check owing to the attacks of the Flower-bud Maggot disease between the years 1907 and 1909, but has now recovered from this to a large extent. In Barbuda the industry is carried on as an estates crop by the Government, about 130 acres being cultivated each year; the enterprise has resulted in placing the island in a solvent condition; formerly it constituted a charge on the revenue of Antigua.

In St. Kitts the crop is grown very largely as an intermediate between two crops of sugar cane; it is also grown to some extent as a main crop; there is no peasant industry. St. Kitts cotton has now attained a very favourable reputation among spinners, and the industry is very firmly established.

In Nevis cotton is grown as a main crop on estates, and there is also an important peasant industry. The crop has very largely replaced sugar, and has exercised a very profound effect on the prosperity of the island.

In Anguilla the crop is almost entirely grown by peasants, and its introduction has resulted in the restoration of a moderate degree of prosperity to a community which formerly existed in a condition of abject poverty. Mention must be made of the efforts of Mr. C. Rey, who, as a local landowner and the agent of the Local Government and the British Cotton Growing Association, has assisted in bringing about the existing state of affairs.

In Montserrat the staple is very largely cultivated both on estates and by peasants; the crop now constitutes the principal product of the island, and its introduction has resulted in the re-establishment of a considerable measure of prosperity.

In the Virgin Islands the industry is conducted purely as a peasant industry, and cotton is widely grown on numerous scattered small holdings on the collection of small islands of which the Presidency is composed. The crop is purchased and exported by the Government through the medium of the Agricultural Department. Its introduction has resulted in the establishment of a greatly increased measure of prosperity among the peasant proprietary of the locality.

The industry may be looked on as firmly established in the Colony; the period of its development is brief, but in that time it has effected a very pronounced improvement in the economic conditions, and now ranks second in importance in the industries of the Colony. The present position must be attributed in no small measure to the unremitting efforts which have been made to foster development. The future of the industry depends on the continuation of favourable market conditions and on the absence of any wholesale destructive agency which does not permit of ready control.

The history of the development of the industry is of interest, and serves to indicate the steps best calculated to promote the development of other agricultural industries under similar conditions.

CAPTURE OF AKABAH.

The recent bombardment and capture of Akabah, though directed against a Turkish fort of no great fame, is important as dealing with a region of political interest, *i.e.*, the frontier line between Turkish and Egyptian territory, which, as recently as 1906, formed the subject of somewhat acute diplomatic discussions, through the occupation by the Turks of Tabah, a post lying a few miles west of Akabah, and consequently on the Egyptian side of the frontier line. The dispute was eventually settled by the withdrawal of the Turkish troops, who had garrisoned Akabah in force, under the plainest intimation from the British Ambassador to the Porte that unless this were done within ten days Great Britain would take forcible steps to drive the Turks back over the frontier line. The

present situation has been doubtless brought about by German instigation, just as the previous crisis was in 1906; but the recent destruction of the Akabah fort by H.M.S. "Minerva" will probably act as a forcible deterrent, though endeavours are being made by the Ottoman Government to move down troops towards the Egyptian frontier, along the Turkish railway from Damascus to Maan, the nearest station to Akabah. From thence westward to the banks of the Suez Canal the Sinai country is sterile and almost waterless, and thus very difficult for the transit of troops without elaborate preparations for transport. The population of the peninsula is about 30,000, all of Arab origin, excepting the Jebalia tribe, said to be descended from the troops despatched by the Emperor Justinian at the beginning of the sixth century, to defend the Sinai monastery from the attacks of the natives. Akabah is quite a small village, shaded by numerous palm trees, which contrast pleasingly with the rocky surroundings. The village itself is a very poor place, consisting of a few mud huts, but the fort which has just been shelled and destroyed by the "Minerva" is said to have dated from the sixteenth century, and was built for the purpose of protecting the pilgrim route to Mecca. The site is believed to have been that of Elath of the Bible, and perhaps identical with Solomon's port where his ships were built for the purpose of trading with Ophir. Another important feature regarding Akabah is that if the well-known project of a trans-Arabian railway from Egypt to the head of the Persian Gulf, and thence to the Indian frontier, should ever materialise, such a line would pass through or near Akabah and Maan, and thus form an important junction with the Hedjaz railway, which has been constructed for pilgrimage purposes to the holy cities of Islam.

TUNNELLING BY MACHINERY IN THE MARITIME ALPS ON THE NICE AND CUNEO RAILWAY.

The boring of the two principal tunnels on the railway which eventually will unite Nice with Cuneo and Turin by the Col di Tenda is making satisfactory progress. At the Braus, 5,950 metres (3 miles 1,225 yards), which traverses the mountain range that separates the waters of the Paillon from those of the Bevera, and emerges about 1½ mile from Sospel, 4,600 metres (5,029 yards) of heading have been driven, which leaves 1,350 metres (1,476 yards) still to be pierced by the Ingersoll rock drills, which are working from both sides. The piercing of Mont Grazian, which separates the Bevera and Roya valleys, about 8 miles east of Sospel station, is now completed. It measures 3,880 metres (2 miles 722 yards) from side to side. For about half this distance it is under Italian soil, although the two ends from which the boring operations were carried on are in France. Both these tunnels are now being excavated to the full size for a double line of rails, and are being lined with masonry. The motive power used for driving the air-compressing machinery which actuates the rock drills is furnished by the Société d'Énergie Électrique du Litoral Méditerranéen from their power stations on the rivers Loup and Siagne, situated at least 50 kilometres (30 miles) distant towards Grasse. The opening of the new line in about three years' time will shorten the distance between Nice and Turin by about 47 miles, as compared with the present route by Ventimille and Savona. It will reduce the distance from Nice to Berne to only 537 kilometres (333 miles) via Turin, the Simplon, and the Lötschberg tunnels, on which part of the line a direct train service has already been established.

THE DEVELOPMENT OF THE TEXTILE INDUSTRIES.

Imperial Wool.—The official measures taken to restrain the export of wool from the British Colonies have two obvious justifications. Supplies of wool are running low in this country, and prudence demands that home requirements should be met even before those of the most benevolently neutral people. Again, wool is indispensable to armies in the European field, and pains are well bestowed in preventing its supply to the enemy. The measures have shown more pointedly than ever before how dependent the wool manufacturing countries are upon the sheep of the British Empire. The gross total figures do not fully illuminate the case. It would seem from them that some three-eighths of all the wool grown is shorn within the Empire, but calculations which bulk indiscriminately fine and coarse wools and include those taken only for local consumption can neither be exact nor highly informing. One is on safer ground in dealing with the commercial clip, or that portion of the whole that is grown in or imported into Europe and North America, and it can be said with sound assurance that of this the Empire furnishes not less than 45 per cent. The quantitative importance is only the beginning of the matter. They are the most select wools, large bulks of uniform quality are available and their properties render them, on the whole, more desirable than wools from any other source. Australian merino is incomparably the chief material for making fine goods, and even the much smaller Cape supply has a niche of its own which no alternative wool quite fills. Although New Zealand crossbred has a considerable competitor in Argentine wool, grown upon sheep of similar strains, it is still the most desirable material for medium goods, for hosiery, and, incidentally, for khaki. The home-grown British wools are of an excellence almost as varied as their breeds, and our special wools are sought for special purposes in every considerable manufacturing country. Their peculiar quality makes the drying-up of all British sources a more

serious matter than might be judged from the comparison of bare figures.

Government Contracts.—The iniquity of army contractors is an article of faith with a wide public, although there has been one at least of whom the English might hesitate to think evil. St. George of Cappadocia was an army contractor in one interlude, and it can be affirmed that in the present the list of contractors to the War Office includes a number of the most unassailable names in the cloth manufacturing world. A current estimate asserts that 250 miles of wool khaki cloth are being produced weekly. Two hundred concerns are working under Government contract and supervision, and all their energies fail to produce cloth enough. Even tapestry carpet looms have been remounted and pressed into the service. Substantially all the looms of which the normal function is to weave fine worsted and woollens are working, to the regret of their owners, upon the difficult khaki. The work is troublesome and tedious, the specifications, as to strength in particular, are almost impossibly high, and the prices paid are not those to which makers of fine cloth are accustomed. It may be believed, therefore, that ignorant charges of villainy are somewhat galling to men who are doing their best and fully satisfying the official standards. As the only buyer the Government has the sellers easily in its power, and the authorities have in addition certain reserves of force. Tolerably plain intimations have been received that the hand of authority is supreme to make and amend prices, to seize material if need be, and to commandeer factories and replace the owners or managers. In these circumstances it is judicious to receive reports of bad materials and workmanship with strict caution.

Cotton Accoutrements.—Cotton has replaced leather in more than a few directions in the past. Bootlaces, handbags, and the realistic leather imitations used for seating afford familiar examples, but it is perhaps the analogy with machine belting that has prompted the new equipment of the private soldier. A broad waistbelt of brown cotton canvas replaces the narrower leather one. The shoulder straps, rucksack, and haversack are of the same material, as are the cartridge belts. The material has been selected with an eye to wear, and the fabrics are made with tightly-twisted five-ply cotton yarn. Doubtless both time and money are saved by the authorisation of this material, and a distinct advantage is possessed by the cotton bandolier. Cartridges can be served ready packed in the belt, saving the trouble of filling pouches on the field, and the old empty belt is cheap enough to be thrown away.

British Dyewares.—The shortage of dyestuffs, having stimulated ingenuity, has led to the discovery of more than one means of widening the scope of the so-called sulphur colours. These have been available hitherto only upon cotton, and have been used especially largely in dyeing black. The dyes resist light, soap and acids well, they are cheap, and made extensively in England. It may not be regarded wholly as a demerit that some dyers call the shades obtained a little flat, like those given by the old-fashioned dyewoods. Messrs. Lodge and Evans, of Huddersfield, have devised one means by which this range of dyes can be used for the animal as well as the vegetable fibres. The colour makers have also been at work, and sulphide dyes are now supplied in a form ready for dyeing wool and cotton in the same bath. The new facility is equivalent to an extension of British resources. Prospectively, at least, British supplies have been further increased by the arrangement of terms for the right to manufacture under German licence. It appears that German holders of English patents expect a royalty of 7½ per cent. upon the net price, coupled with an undertaking as to the minimum quantity to be manufactured.

State-aided Dyestuffs.—Great interest has been taken in the Government proposals for the subvention of a British colour-making industry, but the means of arriving at a fully informed opinion upon them are possessed only by a few. As is the way in all questions of State-aid, there are conflicting opinions as to the policy of giving a twenty-five years guarantee of the debenture interest upon £1,500,000. Some doubts are heard also about the need for an immediate decision, seeing that in any case some time must elapse before a great new factory could be planned and equipped. However, it is not readily to be supposed that these aspects of the question have escaped the large consumers of colour who have been in consultation with the Board of Trade, and unless they had felt seriously inclined to find one or two millions of capital for the proposed undertaking negotiations could hardly have proceeded so far. The chief consumers are, of course, the great combines of commission dyers and calico printers, who are, besides, the largest customers of the German works and purchasers of colour by the thousand tons. They are quite the last people to wish to see colour made dearer in this country, and if, with their sources of information, they are not dismayed at the prospect of the unlimited dumping which some foresee, other persons may take heart of grace. The fear of some parties is that German competition in the future would so depress prices and menace the English colour factory that import duties would have to be instituted to safeguard the interests of the State. If our multi-millionaire dyeing companies commit themselves to the Government scheme it may be taken for granted that they do so after as careful a deliberation as they give to their other investments. To them and to textile manufacturers the manufacture of colour is of secondary interest to its use. A return covering the interest on their outlay would satisfy them, and their knowledge of their own consumption

is such that the prospects of commercial success can be gauged with fair accuracy. Some reasons can be found in contemporary history for refusing to be too much afraid of German prowess.

The Largest Loom.—The largest looms of which this country has any general acquaintance are doubtless those used in weaving seamless carpet squares. On the handlooms for weaving patent or chenille Axminster five men work to pass the shuttle and beat home the weft. But the power-loom that is called the world's largest was built not long ago in Chemnitz for the purpose of weaving felts for paper-making machines. The makers built a loom of 59-foot reed space in 1910, and the new one has a width of 75·4 feet and a shuttle weighing 19¾ lbs. A 9-foot loom being a considerable monster in the ordinary woollen trade the dimensions may be the more appreciated. The loom has been made doubtless to keep pace with the development of paper-making machinery. No statement is made as to the width of the paper machine which the felt is to fit, but it may be apprehended that the loom-width allows generously for the contraction that will take place in course of the felting treatment which the fabric will undergo. Except that the framing is strengthened in proportion to the size, the loom appears to differ little in design from the ordinary. On a machine of these dimensions the reverend inventor of the power-loom might have thought his "springs strong enough to throw a Congreve rocket" less obviously out of place than upon his early model.

GENERAL NOTES.

THE SHORTAGE OF AUTOMOBILE PARTS DUE TO THE WAR.—The difficulties which confront the automobile industry through their past reliance on the Continent for much of the materials of which their cars are constructed, are now enhanced by the fact that all the big steel makers in this country are inundated with orders for war material which naturally must take precedence over all others. The automobile engineer must, however, obtain steel castings, forgings, stampings, and other accessories in order to be able to carry on his business at all, and he is, therefore, obliged to look for some new source of supply. What this source shall be is the immediate difficulty which the Institution of Automobile Engineers is making every endeavour to discover. The first step was the reading of a paper by Mr. L. H. Pomeroy, of the Vauxhall Motor Company, in London, on October 14th (which was printed in the *Journal* of November 6th, pp. 1012-21), but this paper, though it provoked a great amount of interest in the subject, did not provide a solution. Mr. Pomeroy has now been deputed by the Council to make another attempt in the Midlands, and he will read a second paper on similar lines in Birmingham in December. A large number of firms connected with the steel industry, who are already interested in this particular branch of the subject, or who might become interested, have been invited by the Council to be present at the meeting, in order that they may hear the views of the automobile engineer and put forward their own criticisms or suggestions. It is hoped that a large gathering of automobile manufacturers will also be present, so that the whole subject may be thoroughly thrashed out from the two points of view. Full particulars of the meeting and copies of the paper may be obtained on application to the Secretary of the Institution of Automobile Engineers, 28, Victoria Street, Westminster, London, S.W.

HOW TO SUPPLANT THE ENEMY TRADE IN INDIA.—The Indian Commercial Intelligence Department in Calcutta has been considering how best to afford assistance to Indian manufacturers to lay themselves out to produce articles hitherto imported from Germany and Austria-Hungary. The department is accordingly issuing a series of brief memoranda or leaflets on different industries, setting forth statistics of imports, exports, and local production, and other details, including prices and usages of the various markets. It is proposed to supplement these memoranda by an exhibition, to be held probably in Bombay and Madras, as well as in Calcutta, showing samples of certain kinds of goods imported from Germany and Austria, together with samples of similar goods manufactured in India and possibly elsewhere. Samples are already being collected of the following classes of goods: glass ware, enamelled iron and other hardware, cutlery, textiles (especially hosiery and woollen shawls), pencils, matches, and toys. In all of these it is officially considered that there is a clear opportunity of creation and expansion of trade in India.

VICTORIA AND ALBERT MUSEUM.—Mr. J. Lavery, A.R.A., has presented to the Victoria and Albert Museum the portrait which he painted last year of Auguste Rodin. He wishes the gift to be regarded as a tribute to Rodin from British Art. It is designed to reciprocate the sentiments which inspired Rodin to make his magnificent gift of sculpture to the Victoria and Albert Museum, in admiration of the heroism of French and British soldiers who are fighting at this moment side by side. The portrait is almost full length, with the head in profile.

RICE PRODUCTION IN SPAIN.—The Province of Valencia is the most important rice-growing centre in Spain, the average annual crop amounting to some 200,000 tons. Rice, as popular food, enters into the diet of the people to such an extent that the home production is not sufficient to meet demands, and annual imports are necessary. In the Province of Tarragona rice is grown on the right bank of the Ebro River, and in the "Amposta" tract; total production, 29,750 tons in 1913 from 21,004 acres. The Province of Gerona and the Balearic Islands produced considerable quantities.

The two principal varieties grown along the Ebro River are Benlloch and Bomba. Rice-sowing in the Barcelona district is done about the end of March and beginning of April. Harvest begins in August, continuing into early September under normal weather conditions. Much of the work is done by peasants from Valencia, who go to the Tarragona rice fields for the sowing and harvesting.

Reinforced Concrete.—In the course of his Presidential Address to the Concrete Institute, Professor Henry Adams quoted some striking figures to show the progress made in the use of reinforced concrete for bridges. Among the larger examples, he said, we have 233-ft. span in the Walnut Lane Bridge, Philadelphia; 320 ft. at Grafton, New Zealand; 328 ft. over the Tiber at Rome; 330 ft. at Largweiz, in Switzerland—all within 100 ft. difference. Now we have the proposed Spuyten-Duyvil Creek Bridge at New York, where a span of 703 ft. is proposed, or more than double. A steel bridge now under construction in this country for erection across the Ganges is a mile long, in fifteen spans of about 350 ft. each, and will contain 30,000 tons of steel.

Fish Frozen Alive.—Professor Raoul Pictet has been continuing the researches which he described in the paper on "Les Basses Températures," read before the Society in 1911, and it is now possible, according to the *American Journal*, to freeze live fish in cakes of ice, and revive them to their original state after a few months' "cooling." He recently placed twenty-eight fish in a box containing water rich in oxygen, in which several pieces of ice were floating, and then very slowly reduced the temperature. At the end of about two months the resultant cake of ice was gradually thawed, and the fish all found to be alive. It is essential that the water should be very gradually frozen, and that it should have contained pieces of ice for from fifteen to eighteen hours before the whole mass is frozen. The thawing must also be very slow. It is hoped that Alaskan salmon and Siberian sturgeon may thus be shipped alive to Paris.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock:—

December 9.—William A. Young, "Domestic Metal Work of the Eighteenth Century." Professor William Gowland, F.R.S., will preside.

December 16.—Sir William de Wiveslie Abney, K.C.B., D.C.L., D.Sc., F.R.S., "Testing Pigments for Permanence of Colour."

Indian Section.

Thursday afternoon, at 4.30 o'clock:—

December 17.—Dr. F. Mollwo Perkin, F.I.C., F.C.S., "The Indian Indigo Industry." Sir Steuart Colvin Bayley, G.C.S.I., C.I.E., will preside.

Papers to be read after Christmas:—

F. Vincent Brooks, "British Lithography in 1915."

Hon. John Collier, R.O.I., "Portrait Painting."

Octavius Charles Beale, Chairman of the Australian Manufacturers' Association, "Imperial Industrial Development after the War."

Thomas Worthington, "The Work of the Commercial Intelligence Branch of the Board of Trade."

T. Thorne Baker, "The Industrial Uses of Radium."

Frank Baines, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

G. W. Hulme, "Patent Law."

W. T. Thornton, "The Industrial Uses of Coal Gas."

D. Y. Cameron, A.R.A., R.E., "Etching."

Roger Fry, "Post Impressionism in Design."

C. H. Sherrill, "Ancient Stained Glass."

William Poel, "Shakespeare's Profession."

Arthur Wilcock, "Designing for Textiles."

J. A. Hunter, "The Textile Industries of Great Britain and of Germany."

Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

Edward R. Davson, "Colonial Sugar Development."

Major E. H. M. Leggett, R.E., D.S.O., Managing Director of the British East Africa Corporation, "The Economic Development of British East Africa and Uganda."

Henry John Elwes, F.R.S., "Nepal."

Captain Sir George Duff Dunbar, Bart., I.A., "Tribes of the Brahmaputra Valley."

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

January 21, February 18, March 18, April 15, May 13.

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

February 2, March, 2, 30, May 4.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

R. A. Peddie, Librarian, St. Bride Foundation Typographical Library, "The History and Practice of the Art of Printing." Four Lectures.

Lecture III.—December 7.—*The 19th and 20th Centuries continued.* Woodcuts of the Sixties

—Invention of the half-tone—Revival of hand-press work for artistic production—Effect of revival on commercial work—Types and Typefounders—Recent inventions in illustration.

LECTURE IV.—DECEMBER 14.—*The later history of colour printing.* Rise of chromo-lithography—Chromo-xylography—The three-colour process—Collotype—Photogravure and its combinations—The offset process.

DR. F. MOLLWO PERKIN, F.I.C., F.C.S., "Oils, their Production and Manufacture." Three Lectures.

January 18, 25, February 1.

M. H. BAILLIE SCOTT, "House Building—Past and Present." Three Lectures.

March 15, 22, 29.

DAVID SOMMERVILLE, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

FOTHERGILL LECTURES.

Monday evenings, at 8 o'clock:—

PROFESSOR VIVIAN B. LEWES, F.I.C., F.C.S., "Motor Fuel." Three Lectures.

February 15, 22, March 1.

JUVENILE LECTURES.

Wednesday afternoons, at 5 o'clock:—

H. PLUNKET GREENE, "How to Sing a Song." Two lectures, with vocal illustrations.

January 6, 13.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DECEMBER 7...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. R. A. Peddie, "The History and Practice of the Art of Printing." (Lecture III.)

Farmers' Club, Whitehall Rooms, Whitehall-place, S.W., 6 p.m. 1. Annual General Meeting. 2. Professor P. Wrightson, "The Extension of Agricultural Food Supplies."

Royal Institution, Albemarle street, W., 5 p.m. General Monthly Meeting.

Engineers, Society of, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 7.30 p.m. Mr. S. M. Dodington, "Mechanical Appliances for the Painless Killing of Animals."

Geographical Society, Burlington-gardens, W., 8.30 p.m. Professor L. W. Lyde, "Types of Political Frontiers in Europe."

TUESDAY, DECEMBER 8...Naval Architects, Institution of, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 3 p.m.

Asiatic Society, 22, Albemarle-street, W., 4 p.m. Professor L. de la Vallée Poussin, "Ma Définition du Grand Véhicule."

Pharmaceutical Society, 17, Bloomsbury-square, W.C., 8 p.m. Discussion on "The Effects of the War on the Nation's Supply of Drugs and Chemicals."

Sanitary Institute, 90, Buckingham Palace-road, S.W., 7.30 p.m. Professor G. S. Woodhead, "Preventive Inoculation."

WEDNESDAY, DECEMBER 9...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. W. A. Young, "Domestic Metal Work of the Eighteenth Century."

Biblical Archæology, Society of, 37, Great Russell-street, W.C., 4.30 p.m. Mr. F. Legge, "The Religion of Manes and the Discoveries in the Far East."

Automobile Engineers, Institution of, at the Institution of Mechanical Engineers, Storey's-gate, S.W., 8 p.m. Professor W. Watson, "Benzol, Alcohol and mixtures of these liquids with Petrol as Fuels for Internal-combustion Engines."

British Academy, at the Royal Society, Burlington House, Piccadilly, W., 5 p.m. M. Emile Boutroux, "Certitude et Vérité."

Literature, Royal Society of, 20, Hanover-square, W., 5.15 p.m. Professor H. Newbolt, "Poetry and War."

Royal Agricultural Society of England, Royal Agricultural Hall, Islington, N., 2.30 p.m. Annual General Meeting.

THURSDAY, DECEMBER 10 Sociological Society, at the ROYAL SOCIETY OF ARTS, John-street Adelphi, W.C., 5 p.m. Conference on "The Mobilisation of Credit in War Time."

Royal Society, Burlington House, W., 4.30 p.m.

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Rev. D. G. Cowan, "A Visit to Iceland."

Optical Society, at the Chemical Society, Burlington House, W., 8 p.m. Presidential Address, "Ophthalmological Instrument Design, with special reference to Accuracy and Rapidity of Working."

Electrical Engineers, Institution of, Victoria-embankment, W.C., 8 p.m. Mr. E. B. Wedmore, "Automatic Protective Switchgear for Alternating-current Systems."

FRIDAY, DECEMBER 11...Chadwick Public Lectures, at the London School of Economics, Clare-market, W.C., 8.15 p.m. Sir R. Ross, "Government and Military Sanitation in the Tropics." (Lecture II.)

Malacological Society, Burlington House, W., 8 p.m. 1. Rev. A. H. Cooke, "The Geographical Distribution of *Purpura lapillus* (L.): i. In Palearctic Waters; ii In Nearctic Waters." 2. Messrs A. S. Kennard and B. B. Woodward, "On the Non-marine Mollusca of a Post-Pliocene deposit at Apethorpe, Northants." 3. Mr. L. St. George Byne, "On Monstrosities in *Cypræa.*" 4. Mr. J. E. Cooper, "On Monstrosities of *Littorina rudis.*"

Water Engineers, Institution of, at the Geological Society, Burlington House, W., 2 p.m. 1. Mr. J. C. Barrowclough, "Notes on Scraping a 15-inch Trunk Main at Batley." 2. Mr. C. W. S. Oldham, "The Whitton Pumping Station of the Ipswich Corporation Waterworks."

Correction.—Mr. Alan S. Cole, C.B., asks that the following correction be made in his letter on "Map-making and Tapestries," which appeared in the last issue of the *Journal*:—

In the sentence "The pilgrimage of Otto Heinrich, Count Palatine and Duke of Bavaria, to the Holy Sepulchre at Jerusalem, in 1521, is the subject of a mixed topographical and special, or story-telling design, woven in a large tapestry hanging now in the Industrial Art Museum of Munich" (p. 41, lines 7–12), for the word "special" substitute the word "epical."

Journal of the Royal Society of Arts.

No. 3,238. VOL. LXIII.

FRIDAY, DECEMBER 11, 1914.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK

MONDAY, DECEMBER 14th, at 8 p.m. (Cantor Lecture.) R. A. PEDDIE, Librarian, St. Bride Foundation Typographical Library, "The History and Practice of the Art of Printing." (Lecture IV.)

WEDNESDAY, DECEMBER 16th, at 8 p.m. (Ordinary Meeting.) SIR WILLIAM DE WIVESLIE ABNEY, K.C.B., D.C.L., D.Sc., F.R.S., "Testing Pigments for Permanence of Colour." SIR THOMAS H. HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Chairman of the Council, will preside.

THURSDAY, DECEMBER 17th, at 4.30 p.m. (Indian Section.) DR. F. MOLLWO PERKIN, F.I.C., F.C.S., "The Indian Indigo Industry." SIR STEUART COLVIN BAYLEY, G.C.S.I., C.I.E., will preside.

Further particulars of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, December 7th, MR. R. A. PEDDIE delivered the third lecture of his course on "The History and Practice of the Art of Printing."

The lectures will be published in the *Journal* during the Christmas recess.

JUVENILE LECTURES.

The usual short course of lectures adapted to a juvenile audience will be delivered on Wednesday afternoons, January 6th and 13th, 1915, at 5 p.m., by MR. H. PLUNKET GREENE, on "How to Sing a Song."

Special tickets are required for these lectures. They can be obtained on application to the Secretary.

A sufficient number of tickets to fill the room will be issued to Fellows in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions, each Fellow is entitled to a ticket admitting two children and one adult. Fellows who desire tickets are requested to apply for them at once.

LIST OF FELLOWS.

The new edition of the List of Fellows of the Society is now ready, and can be obtained by Fellows on application to the Secretary.

COVERS FOR JOURNALS.

For the convenience of Fellows wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1*s.* 6*d.* each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

FOURTH ORDINARY MEETING.

Wednesday, December 9th, 1914; WILLIAM GOWLAND, F.R.S., Emeritus Professor of Metallurgy, Imperial College of Science and Technology, in the chair.

The following candidate was proposed for election as a Fellow of the Society:—

Meriwether, Hunter M., 3616, Gladstone Boulevard, Kansas City, Missouri, U.S.A.

The following candidates were balloted for and duly elected Fellows of the Society:—

Bates, Onward, 332, South Michigan Avenue, Chicago, Illinois, U.S.A.

Bone, Philip James, New Bedford-road, Luton, Bedfordshire.

Fearnley, Ths., Messrs. Fearnley & Eger, Post Box 223, Christiania, Norway.

Otis, Herbert Foster, The Laboratory, Nahant, Massachusetts, U.S.A.

The paper read was—

DOMESTIC METAL WORK OF THE EIGHTEENTH CENTURY.

By Wm. A. Young.

The genesis of this paper may be sought in a review, which was written in 1912, of Mr. F. W. Bradbury's "History of Old Sheffield Plate," itself a monument of long and patient investigation of a bygone metal craft. The author was kind enough to communicate with me after the review had appeared, drawing my attention to a small collection of old trade catalogues dealing with domestic metal work in the late eighteenth and early nineteenth century, which is one of the treasures of the Department of Engraving, Illustration and Design at the Victoria and Albert Museum. It was my privilege a few months later to assist in the preparation of a catalogue of those catalogues. How Sir Henry Wood obtained a copy, and how he traced my connection with it, I cannot pretend to explain, but he did find me, and his invitation led me to prepare this evening's paper.

Mr. Gerald Lee, in his provocative book on "Crowds," wrote: "The things that real people are really doing when one thinks of it, are soap, tooth-brushes, subsoil pipes, wallpaper, razors, mattresses, suspenders, tiles, shoes, pots and kettles." Quite a useful list of articles on which to start housekeeping or shopkeeping; and when you come to think of it, the point of view is at once sane and as old as the hills. The Studley Royal Bowl may become in the course of years the gem of a national collection, or the Ashburnham Salt a priceless addition to a millionaire's museum, but such articles are the super-things of an artistic past A craftsman of Cellini's ability naturally finds his biographer, but the homely worker of the town and country passes away leaving here and there evidence of his craftsmanship, but at best, only some casual record of his name or reference to his circumstances.

If, then, you want to find out what the common people were really making for each other, you must look into your provincial museums, peep into the windows of curiosity shops, and linger on the doorsteps of the older country cottages. It is a matter upon which we, as a nation, may congratulate ourselves that there is growing up a considerable body of collections largely comprised of these objects of everyday use and life. Personally, I know of such museums at Canterbury, Maidstone, Lewes, Brighton, Hull, Ipswich, Hastings, Guildford and Ely. Each has its special features, and all have yielded something to my knowledge of this subject of domestic metal work.

Directly you begin to investigate the by-ways of a bygone craft, certain problems present themselves. Study the subject from the standpoint of social economy, and you are helped by writers like Mr. George Unwin, who can reconstruct the conditions and circumstances of the past on moderately definite and sure foundations. The evidence available discloses the swing of the pendulum between manufacturing interests and capitalistic control. Once in a while the makers of the wares are predominant, but more often, I am afraid, the merchants with money at their command had masters and journeymen alike under their thumbs. We are apt to look upon this matter as involving two interests, labour on one end of the see-saw, capital at the other, with the former, according to the caricaturists, usually in the air. The eighteenth century industrial quarrels, however, were usually triangular affairs, with merchant, employer and journeyman at the corners.

The Practical Side of Bygone Crafts.

If the past story of a craft or group of crafts is studied from the practical side, which is really a somewhat neglected phase, a quite different set of problems is encountered. There are plenty of examples of the work of common workmen, but a very limited literature on the subject. What you can learn of the work must be gathered from the articles available for examination, and if that line is followed certain questions come into mind. Where did the workers of any period turn for a continuous and regular supply of materials proper to their trades? What sort of tools had they and who made them? How did they distribute their wares after they were finished? These, briefly, are the questions I want to try to answer in relation to the metal trades of the eighteenth century, chiefly on the domestic side.

There is a supplementary question arising out of the others. How does it happen that the quality of the work varied so much? Take such a commonplace thing as a gridiron. Why were some of them so elaborately wrought? Some may be ornate in detail and accurately fitted together, while other specimens of like or similar wares are pretentious and unsatisfactory in workmanship, or again simple in form, appropriate to their purpose and admirably

made. How can you account for these differences?

To my mind, nothing calls for more admiration than work exhibiting an economical use of material to produce a given result. The simple is often more artistically true than the elaborate, and the maker of a simple article is often a first-rate workman. Differences in artistic merit, workmanship and style must have been chiefly due to the capacity of the worker, or to natural aptitude. Some were imperfectly trained, or they may have been careless, but others, I feel sure, were hampered by the quality of their materials. A third reason for difference in results would have been in the tools. Some men must have possessed too few for their crafts, and those not always the most suitable for the work they had to perform.

WHERE THE MATERIALS AND TOOLS CAME FROM.

Concerning the materials, you can get a pretty good idea of the position from Yarranton's treatise entitled, "England's Improvement." It is a little earlier than my period, but it is most amusing. Had Yarranton lived in these times he would have been a Tariff Reformer, a whole-hogger. His biting comments on Continental iron shipped to London in competition with native bars from Sussex and the Forest of Dean are thoroughly illuminating, and the reader soon learns that profit before patriotism is not a characteristic peculiar to the twentieth century and a state of war.

The tool problem is, perhaps, the most puzzling of all. The literature on the subject is scrappy, scattered, and rarely contemporary. The examples in our museums are put into cases without any sort of chronological sequence. Nor can you blame the curators of these places for the lack of arrangement. Tools descended from father to son, or passed from employer to journeyman, or from man to apprentice. Most of them were doubtless worn out ultimately and discarded. A few were left in buildings in course of construction, or became hidden in shops where the trades were carried on. They have been found in the demolitions preceding reconstruction; but that fact is more likely to hinder than help those desirous of allocating them to their proper place in the history of manufactured things.

England of the eighteenth century might have been, although it was not quite, independent of outside sources of supply in the metal trades. Iron, copper, tin, and lead were all native materials; brass and pewter she alloyed, the former in Bristol and Birmingham, and to a lesser extent in London. The craft of the pewterer was mainly a London trade, though it was also followed in the provinces. It would not be possible in the time at my disposal to discuss the workshops turning out these metals. In choosing the iron industry for detailed consideration, I have been influenced by my own interest in the ironworks of Kent and Sussex, partly also because I have been able to get some contemporary sketches of this trade with which to illustrate my subject.

HOW THE WORKS WERE ESTABLISHED.

Before the days of steam three things were necessary to the establishment of a successful works: natural power, mechanical means of converting power into work, and air-blast. The situation of an ironworks was determined by the possibility of fixing a water-wheel. The efficiency of the works depended largely on the hammer. The quantity of material produced must always have been roughly proportionate to the number and quality of the bellows.

These were considerations which, more or less modified, must have harassed every eighteenth century manufacturer engaged in winning merchantable metals from native ores. It was not until Watt, Boulton, Cort, and the Darbys came to the front that rapid progress was made. It is curious to notice how the metal trades of our period were hampered because inventions lay undeveloped. Dud Dudley discovered the way to smelt iron with coal about 1619, but it was 1735 before the Darbys began to use coke freely at Coalbrookdale. Even then progress was slow in other places, and as late as 1788 charcoal was the fuel burnt in most of the Sheffield furnaces.

The transition from the tilt hammer to the rolling mill was not so slow, but the old method has lingered right down to the twentieth century. It is quite a mistake to suppose that the steam-engine rapidly replaced the water-wheel. Twenty-two years ago I had a share in demolishing a water-wheel that had supplied power for three generations in an engineering shop employing two hundred men. It drove the foundry blower, all the shafting in the machine shop and sawmill, and a fan for eight forges. The weight of evidence proves that although Boulton and Watt made the manufacturer's decision easier when he had to choose his location, that decision still leaned towards a water site.

How slow the change from wheel to engine really was has been shown recently by Professor

G. J. F. Lloyd in his book on the Sheffield cutlery trade. In 1770 the Rivers Don, Loxley, Rivelin, Sheaf, with some smaller streams in Hallamshire, were turning 133 wheels, and operating between them nearly 900 grindstones, while twenty-eight other wheels were driving as many rolling mills, tilt-hammers and forges. A quarter of a century later there were 118 wheels and five steam-driven works. The higher efficiency of the newer power is shown by the figures. Twelve wheels on the Don then drove 332 grinding troughs, but three of the five steam-plants accounted for 320 stones. Seventy years later, in 1865, there were still thirty-two wheels on the rivers in the district.

The windmill has never competed seriously with the water-wheel as a motor for workshops of the sort we are considering. It was too intermittent to allow of its being utilised for any industry involving the payment of wages week by week. The miller working alone found wind-power as cheap and nearly as serviceable as water. It was no good to an ironmaster whose prosperity depended upon the continuous conversion of ore mined by one gang of men and the equally continuous absorption of the charcoal burned by another gang working elsewhere in the district in which his works were erected.

Of Bellows and Tilt Hammers.

An inquiry into the evolution of the bellows would doubtless yield some valuable information on the steps through which metal-working progressed in the past centuries. In the small, but little-known, museum at the Record Office in Chancery Lane there are two sixteenth-century drawings attributed to Lord Burghley. They illustrate a phase of the lead-smelting industry of Derbyshire. One described in one corner as the "Old Order," shows two men, each standing on a pair of bellows, the nozzles of which are directed towards something meant to represent a furnace. A rough frame is shown behind the men, who were assisted in their labour by two saplings slung in the frame so as to counterbalance the bellows. The other picture, which is inscribed "BurchardesFurnise," is quite an elaborate affair. There is a rough representation of a water-wheel outside the wall, with gear connecting in some way to an overhead shaft of wood in the smelting-house. Four bellows are shown attached by as many connecting rods to the shaft. How the rotary motion of the wheel was to be converted into the reciprocating movement necessary to the working of the bellows, my Lord of Burghley left his millwright to work out in detail.

Mr. Charles Dawson, of Lewes, has kindly lent me a photograph of a clock-face made at Ashburnham, which was the centre of one of the Sussex ironmaking areas. The dial shows in a delightfully quaint fashion some of the phases of the industry: digging the ore, cutting down the trees, charcoal-burning, the interior of the forge, the foundry, and even the check-weighing of the cannon and other output of the works. The picture is the only contemporary representation of a Sussex ironworks of which I have any knowledge.

With regard to tilt hammers, Mr. Lewis, another Sussex antiquarian, suggested in this room some years ago that the original tilt hammer was merely pivoted a little out of the centre. There was a free end opposite the tup on which one or two men stepped to raise it. When they stepped off the blow fell on the metal on the anvil. Afterwards the blow depended upon a cam, or the sprocket of a star wheel on the water-wheel shaft. Sometimes the pressure was exerted on the top of the free end of the hammer beam, at others under the beam between the pivot and the tup. By these primitive means a good merchantable bar of useful length was hammered out of the bloom. It is on record that as early as 1300 the farrones, or ironmongers of London, were agitating against the Sussex ironmasters, who were delivering iron bars so short that their customers' work of making tyres for cart wheels was rendered difficult.

Henry Cort's proposals in 1784 to make iron bars by rolling was only an extension of metal practice. A Major Hanbury who died in 1734 had applied rolling to tinplates, and it is possible that he knew something of the invention of Edmund Henning, who took out Patent No. 262 in October, 1691, to make "iron plates tynned over comonly called tynned plates as good as those brought from and made in Germany." All our current talk about capturing German trade is a very old cry after all!

It was while operating a pair of rolls in an endeavour to elongate a strip of close-plated metal that Bolsover in 1743 conceived the idea of making the silver-on-copper sheets out of which grew the Sheffield plate industry. Rolling for the trade became, as the years went by, an established industry. Bisset's illustrated directory of Birmingham, which was issued in 1800, records several names of firms engaged in it, including that of Matthew Boulton, who

seems to have been a partner in at least half a dozen businesses. In one instance he and another are described as rollers of mixed metals.

The Evolution of the Moulders' Art.

Such, then, were the main equipments of the works from which the craftsmen obtained their materials. The records of the century prove that the little masters were not behind the manufacturers, and that they rose to the possibilities of improving materials, tools and methods. The Sussex moulder who cut a twig from the hedgerow in 1615 in order to ornament his fireback belonged to a race of whom Professor Lethaby wrote that they "knew nothing of art, but wrought it; talked nothing of beauty, but thought it," decorating what they made "with a childlike directness." Quite at the other end of our period I have a slide showing some stove patterns—beautifully carved panels—executed by the Haworth Brothers, who had been students, in Sir Joshua Reynolds' day, at the Royal Academy.

The simple backs of the Sussex "sand-rats" possess a value all their own, but none would wish to reproduce them for use again, whereas the collections of late eighteenth century models in some of our older foundries have been utilised over and over again, and remain as welcome as anything the latest art schools can give us. It is a fine tribute to those artists I have mentioned that their designs are so readily adaptable to modern fireplaces.

Until the foundry business was shifted from the South-Eastern counties of England to the Midlands and Scotland, the casting of iron for domestic purposes seems to have been a singularly restricted trade. Cannon was the chief output, but firebacks and andirons must also have been made by the hundred. The irons served to support the wooden logs on the hearth, while the backs protected the brickwork from the fierce heat of the burning wood, and incidentally served to ornament the centre of many an English home. As soon as the more energetic Midlanders and Scotsmen took up the trade, they branched out in all sorts of ways.

Progress in Kitchen Utensils.

Thus we read that at Carron in 1784 the works were turning out kitchen ranges, which had been invented earlier than that by Bodley, an Exeter man, grates and stoves, kettles, teapots, saucepans and frying-pans, which are described as "neatly and solidly tinned." There is a catalogue of some of these items in the Victoria and Albert Museum, but it is a little later than the eighteenth century, for the water-mark in the paper is 1810. That catalogue comprises a good many additional items such as window fittings, axle pulleys, knockers, and a wider range of pots and pans than the Carron list suggests.

A good deal of information about the development of kitchen utensils can be gathered from patents' specifications. A quite superficial examination of the eighteenth century files has thrown a lot of light on the foundry trade of the period. Among other facts I have discovered that tumbling small castings in a barrel to brighten them is at least 150 years old. In catalogues, old or new, comprising cooking utensils, you always find a drawing and description of a digester. It is one of the oldest iron cooking pots we have, and was the invention of Dr. Denys Papin, a Fellow of the Royal Society. Papin claimed for his pot that "the oldest and hardest cow beef may be made as tender and as savoury as young and choice meat." He did not take out a patent, but issued in 1681 a little book about it, in which he stated that he had "instructed Mr. Mayor, a founder in Old Bedlam, how to make these engines in cast brass, so that anyone may see and buy them of him." Evelyn, under date April 12th, 1682, refers to a meal cooked in a Papin's digester. If we are to believe the diarist, beef and mutton bones were made as "soft as cheese without water or other liquid with less than 8 ozs. of coales."

The transition from copper to iron for kettles had certainly begun in 1754, for in that year W. Johnson applied for a patent relating to their manufacture. He proposed to take "an iron barr and hammer or roll it in a rolling mill to such size or substance as might be necessary for the size of a kettle, boyler or furnace." The sheets thus produced were to be put together with iron forge rivets in the same manner as copper ones. The specification thus enlightens us on several points relating to sheet-metal working, but unhappily leaves us in doubt about the spout. That part of a kettle has always been a hard nut to crack. I recall a conversation with an old ironfounder long since dead. He used to tell with great gusto a story about his grandfather or grand-uncle, I forget which, who could not get his spouts as neat and sound as a rival. He solved the difficulty by disguising himself as a labourer and offering to help a barge-owner to carry pig-iron into the competitor's foundry. History repeats itself, and

since aluminium has come into use, kettle makers have had to tackle the spout problem again, but let us hope in a more neighbourly spirit.

A plain black iron cooking-pot is not entirely nice, and that fact was recognised early in the trade. In 1673 one William Chamberlain took out a patent for a method of "plating tynning of iron, copper and brass." His method appears to have left something to be desired, for more than ninety years afterwards Maurice Clifford applied for a patent to "tin copper which is wrought and pickled and then freezed in the inside on a stake as rough as a coarse file or any other method of freezing which opens the pores of the copper and makes the tinning penetrate." Before the end of the eighteenth century one Hickling had discovered means of coating the inside of culinary utensils with an enamel glaze.

The Art of the Domestic Smith.

Enough of pots and pans; but before dismissing iron some notice must be taken of the domestic smiths. There is possibly no more fascinating craft; it is of great antiquity; it is full of variety, and has always been marked by originality and individuality. Those last-named characteristics had free play in the past, and they will never be entirely eliminated, even in an age when hard work is relegated to the machine-run shop. The man who can take a bit of iron or steel and fashion out of it some useful or ornamental article with a hammer in his hand and the design in his brain is a smith, no matter whether the product of his labour is a simple horseshoe, a highly decorative fitting like a chimney crane, or a tempered instrument. If you will examine carefully the domestic ironwork of the seventeenth and eighteenth century at the Victoria and Albert Museum, you will reach the conclusion that I have reached—namely, that the work is honest hammer and anvil work. Those men used the drill sparingly, relying upon punches for holes, and fullers and sates for fashioning the tenons that fitted them. I am fortunate in being able to illustrate a variety of work that has not hitherto been photographed, while other slides disclose the interiors of several shops in which locks and hinges were made.

A good deal of the individuality that characterises the smith's work must have been due to the way the work was carried out. Until repetition of patterns became general, the builder would finish his share of a job before the smith came on the scene. Then he would make his crane to the chimney, his grille to the finished door-head or his lantern holder to the gateway. Not invariably, but generally, the ironwork would represent the smith's own ideas of fitness, and that, I feel, accounts for much that is fresh, artistic and human in wrought-iron work. Those old smiths had a splendid control over a somewhat hard metal, and they exercised a fine restraint and a commendable economy in the quantity of material they put into a job.

Of the Bell-Founder's Part.

Passing on to copper and its alloys, it is clear that at the beginning of the period brass and bell-metal were used for making cooking utensils for the kitchens of the well-to-do and merchant classes. These were cast in the bell foundries, of which there were a large number in London and the provinces. It seems not unlikely that the decay of bell-founding in the eighteenth century was accelerated by the increasing encroachment of cast-iron cooking utensils. When the orders for skillets and mortars fell off, the bell-founder may have found it hard to keep his works going. Church bells are not wanted every day. In London alone there used to be bell-founders in Shoe Lane, All Hallows in London Wall, Windmill Hill in Clerkenwell, Fleet Street and Whitechapel. There are only two such foundries left. That in Whitechapel has been carried on continuously since 1567. Lester and Pack, who owned it in 1762, cast a bell in that year in the precincts of Westminster Abbey, which fact reminds us that the founding of a bell in a churchyard—sometimes even on the floor of the church beneath the belfry tower—was commonly practised in the country. The method saved a lot of hauling and lifting when the bells came to be hung. On such occasions the people seem to have seized the opportunity of renewing their pots and pans. Thus we read that when a bell was cast at Bridgewater in the thirteenth century 36*s*. 2½*d*. was received for "three leaden vessels with two trivets, one bason with laver, pots and brass that have been sold." In the London Museum, now so worthily housed at Lancaster House, there are two capital mortars which were cast at Whitechapel during our period. As I have hinted, the establishment of iron-foundries in the Midlands, which were managed on factory lines, must have seriously affected the prosperity of the bell-founders. I do not find in Bisset's Directory any evidence that the making of bell-metal cooking-pots was a Birmingham trade in 1800.

While the domestic end of the bell-foundry trade was decaying, there was growing up a remarkable industry in Birmingham, which owed its growth to the increasing wealth of the middle and lower middle classes. With more money to spend there was a surplus after things to eat and wear were provided. Men, and particularly women, I expect, began to look around for more things to use, and naturally furniture began to attract attention. If half the eighteenth-century furniture offered in our curiosity shops is genuine, cabinet-making in those days must have been a prosperous and profitable trade, and its prosperity was reflected in Birmingham.

The Beginnings of Brassfoundry.

The rise of the brassfoundry trade in the Midland city is being investigated at the present time by a committee, whose editor is preparing a history of its rise and developments. Birmingham has been the home of the hardware trade for a very long period. Leland in 1538 wrote in his itinerary that: "There be many smithes in the town that use to make knives and all manner of cutting tools, and many lorimers that make bittes, and a great many naylors."

Half a century later Camden set it down that the town "swarmed with inhabitants, and its streets resounded with the noise of anvils." No reference here to brass, and indeed as late as the Restoration iron was the chief metal wrought in the Birmingham shops, where were "produced instruments of war and husbandry, furniture for the kitchen and tools for the whole system of carpentry." When, however, furniture makers began to weary of wooden latches and handles, and called for something brighter than iron, Birmingham was ready with new ideas.

In competition with Bristol and other centres where brassfounding was already established, Birmingham set out to win a share of the new business, with what permanent success her present position in this department of metal work attests. The instant success of the firms who went into the business is not hard to understand. So much that was required by the new craft was merely modifications of existing trades. The foundry processes were not very different, and the subsequent treatment of the articles must have been familiar to the workmen. Filing, grinding, chasing and burnishing were in the blood of the local workmen, and a new commercial spirit was abroad among their employers. It would have been surprising if the industry had not thriven. How considerable it had become by the end of the century is discoverable from the catalogues at the Victoria and Albert Museum. Twenty-five of them relate to cabinet-brassfoundry, and the variety of articles illustrated is so remarkable that, personally, I have come to the conclusion that all that are represented in the books were not actually made. It appears to be more probable that designs were prepared for trade purposes, and then, if orders came along, the patterns were made and the goods turned out.

An Early Business Combine.

All the same the business attained big proportions, and in 1780 thirty casters of brass in the town were melting down a thousand tons of brass per annum. In that year the actual makers of the alloy advanced the price of ingots, and the casters had to pass on the burden by increasing their prices by 7½ per cent.—a step which was described as a "disagreeable necessity." That was in August, and on October 9th there appeared in *Aris's Gazette*, a local newspaper, "a serious address to the merchants and manufacturers of hardware, and particularly the inhabitants of Birmingham and the adjacent towns." The writer, who signed himself "Bristol," spread himself to an inordinate length, but he made out a serious case against the smelters of copper and the makers of brass. The casters and their wholesale customers learned that "they are imposing on you an enormous advance of more than twenty pounds per ton on copper and upwards of thirteen pounds per ton on brass, without any other reason than that they presume on their power under such association, and that the same must and will be received tamely by you."

The taunt had the desired effect, and "Bristol's" suggestion that a co-operative works for the production of brass should be started was taken up by the victims. A meeting was called in November to discuss the project, and in 1781 the new Brass and Spelter Company was formed with a capital of £20,000. The works, of which I can show you a picture, were off Broad Street, and the thoroughfare to this day is known as Brasshouse Passage. Boulton seems to have taken a keen interest in the preliminary plans, although his other and numerous enterprises precluded his accepting the proffered chairmanship. Unfortunately the shareholders quarrelled with him when the site for the smelter came to be discussed. Boulton favoured Swansea. "If," he wrote, "the works are erected in Birmingham, the work will be

constantly deranged by the interference of a hundred blockheads," and instead of being assisted, will be incommoded by every subscriber that chooses to take an idle walk by ye bank of ye canal." I confess I like Matthew's blunt style, and I am not surprised, when the local majority prevailed, that he resigned. All the same I suspect he left his money in the concern, and became one of its best customers.

Brassfoundry with a Difference.

Side by side with brass-casting there grew up in Birmingham a kindred craft, which was, and still is, described in contradictory terms. Stamped-brassfoundry grew out of the invention of a Londoner named Pickering, a gilt toy maker. He patented in 1769 "a new method of performing that kind of work called chasing, for gold, silver, brass, tin and other metals, but more especially to be used in the production of coffin furniture, also ornaments for coaches, chariots, cabinet brass work and domestic furniture." Pickering claimed that his method was more expeditious than anything then practised, and that it was "far superior in beauty and elegance to anything of the kind (not being actual chasing) ever yet performed."

It is quite clear from this that the cost of chasing was the bugbear of the finishing departments, and the circumstance confirms my own view that a good deal of the metal turned out in the foundries was sold "out of the sand." You cannot explain such prices as 7*s.* 6*d.* for an elaborate cast-brass clock in any other way. There is evidence that these articles were sent to France, and my own opinion is that they were chased and lacquered by French workmen for the French markets.

About this time a Birmingham brass and copper worker adapted stamping to more utilitarian wares—to warming-pans, to scale-making, and to frying-pans. A few years later John Marston, a brass-caster in the town, and Samuel Bellamy, a die-sinker, devised means for piercing brass, and employed coloured foils behind the perforations to enhance the appearance of their wares. There are some admirable examples of this sort of work represented in a catalogue marked "R. & Co.," and published probably about 1780. The handles, cloak-pins and escutcheons shown are described as "japanned middles set in gold coloured rims, with mahogany moco, tortoise and green grounds." I confess I do not know what a moco ground was like, but it sounds rich. Other decorative features included enamelled centres, of which there are examples at Brighton, and not long ago I came across a piece of furniture in the Leicester Museum mounted with this type of handle, though one is inclined to question the accuracy of the official description, which ran, "handles decorated with Battersea enamels."

As the stamped-brassfoundry trade grew, comparatively large pieces such as picture and mirror frames came to be made of sheet-brass. I have not had an opportunity of examining an authentic example, but I cannot think they were made in one piece or at one operation. The pattern always repeats, according to the books, and I expect the metal was stamped and shifted for its whole length. Any little irregularities arising from this way of working could be made good with a hammer and punches, and the frames would be mitred together, sweated or brazed and then polished, water-gilded and lacquered. There are two other brass departments represented by the catalogues—cock founding for brewers and plumbers, and fittings for lighting. The former seems to have been begun in Birmingham about 1770, but the catalogue is of later date, and the gas-fitting trade did not begin before 1812, in which year Murdock discovered how to make coal-gas.

Tin Wares for the Poorer Folk.

Brass and copper wares, however, were still beyond the purchasing power of the common people, who were the chief customers of the tinplate workers. All through the century it was a pretty well organised industry, and the interests of those connected with it were well served by the Worshipful Company of Tinplate Workers, *alias* Wireworkers. Their charter was granted in 1670, on the petition of the men engaged in the trade, and the records show that a hundred of the journeymen paid a subscription to the funds raised to secure incorporation. Southwark was the centre of the trade, in which were men who were by no means backward in asserting their rights. They prosecuted pedlars who hawked inferior wares from door to door, they discharged their own officials on proof of their neglect of duty, and fined shifty members of the company who were caught making goods of "damaged stuff and materials." Their authority extended beyond London, as far indeed as Woolwich, Northampton and Worcester. An interesting bit of special work was the periodical publication of a piecework book, affording the basis upon which wages were paid to workmen. The first was issued in

1695, and the list has been revised seven or eight times, the last occasion in 1900. The list of contents in the fifth edition of 1761 contained the names of many articles no longer used, or if used, no longer made in tinplate. It is rather to be regretted that there is no catalogue of domestic tinware at South Kensington. Possibly the trade was purely English, and without a foreign trade there may have been neither need nor inducement for catalogues.

Pewter as a Domestic Metal.

Until the fifth decade of the eighteenth century the metal commonly used for the table appointments of the middle class was pewter, and a garnish of pewter was to be found in most houses, and also in the mansions of the well-to-do, who would use the ware for everyday use and in the servants' hall. Comparatively little has come down to us, and I explain that fact on two grounds. The metal is soft, and consequently as soon as it went out of daily use and was no longer subject to continuous care, it would become shapeless and dirty. The other reason lay in the ease with which pewter could be remelted. The commonest articles, plates and dishes, were made by pouring the metal into iron moulds, and there would be no inducement to harbour bent, cracked and worn-out utensils. The lumber-room has saved a great deal from destructon, but why put old plates in the attic when the itinerant pewterer was prepared to melt them down on the kitchen fire and leave you as many, or nearly as many, new ones at the cost of a few shillings? I do not suggest that that was universally done; probably most of the old metal went back to the shopkeeping pewterers, who made an allowance for it consistent with the price of tin and the value of the order for new wares. One meets this "contra" system at all sorts of turns, and it is pretty certain it was customary in all trades. There is only one reference to pewter in the Victoria and Albert Museum catalogues, and that is in the nature of an interpolation. In the ironfounders' catalogue to which I have referred there is a sheet of MS. on which there is a note that "the price of pewter plates and dishes fluctuates sometimes four times per annum, and sometimes more frequently." As there are neither particulars nor prices of pewter wares in the catalogue, the presence of the sheet is explained by assuming that the founder factored the goods—that is to say, he bought them for resale, sending consignments with his own wares r his customers required.

The Invention of Sheffield Plate.

In 1743, however, a new industry was begun in Sheffield, which was to compete with silver in beauty and attractiveness, and in price with pewter. The wares that the new craftsmen began to produce were known as Sheffield plate; they are now universally described as "Old Sheffield Plate." The Victoria and Albert Museum is fortunate in possessing half a dozen catalogues devoted to this branch of the metal trades. From fragmentary evidence carefully collated, Mr. Bradbury has been able to prove that the volume of business in these wares at home and abroad assumed remarkable proportions, and four of the catalogues bear marks which show that they were used for trade with the Continent.

Most Sheffield plate is what is technically called hollow-ware, and is made from a sheet of metal, silver on one side and copper on the other, or silver on both sides with copper between the two. It was the invention in 1742 or thereabouts of Thomas Bolsover, a Sheffield cutler, who hit upon the method, after passing a piece of close-plated strip through the rolls. His material was a little too short for his job, and when he found the rolls elongated it without separating the constituent parts, he thought the matter out and began to experiment. His process is now known as plating by fusion. The first step was to prepare a copper slab or ingot containing a little zinc and lead. A commonly used size was 8½ ins. by 2½ ins. by 1½ ins., the last dimension being the thickness. The top surface, or both top and bottom, if two silver faces were required, was filed flat and scraped smooth. Then a strip of silver slightly alloyed with copper, or two in some cases, was made ready in the same way, and the two or three pieces were superimposed with the prepared faces in contact. The outside silver surfaces were then covered with other strips of copper or iron coated on the contact sides with whiting. The three, or five, pieces were then wired together and the joints painted with a borax flux. As soon as the last-named was dry the block was ready for the furnace. This was heated with a clean coke or charcoal. As soon as the observer saw the silver begin to "weep," that is to melt at the edges, he withdrew the block from the furnace with tongs which seized the sides. When the block was cool, the wire was removed and the copper plates taken off. The ingot was now ready for the rolls, in which it was reduced to the usual gauges for making hollow-ware, candlesticks and fancy articles.

The quality of the resulting product was, of course, proportionate to the original thickness of the plate or plates of silver, which varied from as little as $\frac{1}{16}$ in. to as much as half an inch. The material lent itself to die and press-work, to repoussé, and to piercing. Bolsover did not at first grasp the possibilities of his own invention. His own trade lay chiefly in small articles, buttons, buckles, and patch and snuff-boxes. A cutler by trade, he seems to have cultivated that side of his business. His apprentice, however, one Joseph Hancock, developed the new industry, and became in time a roller of silver-faced copper to the trade, dropping the manufacture of finished articles as his business grew. Sheffield was the home of the trade, but London and Birmingham entered the field later in the century, and Matthew Boulton was one of the men to engage in it. Bolsover was neither the first nor the last to experiment in plating. The files of the Patent Office include references to Horsley's method in 1783, which consisted in filling plates or leaves of metal with lead or a hard alloy of tin and spelter, while in 1779 one William Bell invented a process for making buttons and buckle shells, by passing sheet metal through rollers, one of which was engraved like a sunk die, while the other had the corresponding embossed design on it. In 1790 John Whitworth sought protection for his method of reinforcing a silver-lined mould with a resin-faced tinplate backing which was pressed into it.

Toys and Toy Shops.

These references to fancy wares and their manufacture bring me to a curious branch of the retail trade known as "toys." The term has nothing to do with playthings, but is applied to those little articles which add so much to the amenities of social life. Nowadays it is practically always qualified by the word "steel." Steel toys include corkscrews, keyrings, button-hooks, nutcrackers, and the like. They usually constitute part of the stock-in-trade of the cutler, the tool dealer and the ironmonger; but the lady of fashion and her male companion in the eighteenth century went to the toy shop for many odds and ends. We may turn to three contemporary sources for enlightenment about these places of business. In the early part of the century the advertising columns of the *Spectator* afford plenty of references to the toy-shops in London. All sorts of things were mixed up with the regular wares, and I expect the proprietors of these specialities paid for the advertisements through the occupier of the shop where their goods were exhibited and sold.

Here are a few examples of what were offered: At Mr. Markham's, at the "Seven Stars," under St. Dunstan's Church, and at Allcroft's in Cornhill, a quack medicine, which would cure anything, from apoplexy to infant fits, was sold side by side with toys. Mr. John Hannam, who kept a similar shop at the sign of the "Three Angels, near Foster Lane in Cheapside," sold a Spanish blacking for gentlemen's shoes. A few months later, in 1711, he advertised a mouth-wash and "incomparable perfuming drops." Two years afterwards there were four angels presiding in or near Foster Lane, for the business was then owned by Mrs. Hannam, who was pushing a hairwash. Another toy-shop, opposite Garraway's Coffee House in Exchange Alley, was kept by a Mr. Penkethman, who took subscriptions for engravings. More to the point is a later advertisement of Allcroft's, who styled his shop "The Blue Coat Boy." He offered "Venetian straps neatly fixed on boards" for polishing razors, penknives and lancets. It is significant that this article, which was sold for a shilling, was also offered by a Mr. Cooper, whose toy-shop was at the corner of Charles Street in the Strand. It seems pretty certain that the toy-shop was a centre of daily gossip, and that the "Jew" in the West had no dealings with the "Samaritan" in the City. Thus the novelties had to be offered East and West of Temple Bar.

Side Lights on Toy-making and Selling.

At the other end of the century there was Bisset's Directory, to which I have already referred; but of 335 entries in the index twenty-four relate to toy-makers whose wares are described as steel, brass, wood, glass or ivory. The term had a wide significance and covered pencil cases, watch chains, buckles, snuff-boxes, buttons and snuffers, besides some of the articles already enumerated. Bisset claimed that Birmingham possessed the toy-shops of the world, wherein—

> "Inventions curious, various kinds of toys
> Then occupied the time of men and boys."

I ought to have explained that this directory is introduced by a rhyming itinerary of the city. It throws a curious sidelight on child-labour, for a few lines further on we read that—

> "Blooming girls at work were often seen
> That twice their ages joined were scarce fifteen."

By way of extenuating this exploitation of children, Bisset praises the "salutary establish-

ment of the Sunday-school," where the unhappy youngsters, after working all the week, were taught to read and write and "every attention is paid to their morals."

The third contemporary account of a toy-shop is in R. Dodsley's play of that title. The master is represented as "a general satirist, yet not rude or ill-natured; he will strike a lesson or illustration out of a snuff-box, a thimble or a cockleshell." The description of the shop is amusing and lively. The proprietor advanced money on watches and jewelry, and had a word for all who came to his counter. The customers represented include a woman wanting a mirror, another asking for a little box, a bevy of ladies in search of a stuffed dog, and a gentleman needing an ivory pocket-book. Another dandy is hypercritical about the adornment of snuff-boxes, and is severely handled by the toyman; but a young man who asks for a plain gold ring and denies that it is for his bride, withdraws the lie when the old man gives him a little fatherly advice. A woman buys a mask, and an old man tries spectacles with tortoiseshell and silver rims. There is not much hardware here, nor much metal, but it is clear the stock was remarkably varied. Just by way of comparison I took a turn, while I was writing this paper, in Cheapside, where there is just such another shop, and if I had dared venture in without making a purchase, possibly I might have encountered a similar philosopher amid quite as mixed an assortment of wares. Anyway, over two centuries the toy-shop keeper has always been the snapper-up of unconsidered trifles, the Autolycus, in short, of the retail trades.

Beautifying a London House.

The overlapping which this inquiry into the toy-shop business has disclosed was not peculiar to the distributing trades. Some years ago I had an opportunity of abstracting some entries from the domestic accounts of a family residing in Dover Street, Piccadilly, with a country house at Gosfield. The period covered extended from 1726 to 1736, during which time the house in Dover Street was "repaired and beautified at a charge of £850." The Hon. Mrs. Knight was a shrewd businesslike woman, who chose her tradesmen with a nice appreciation of values. Her first ironmongers were William and Charles Sparke, whose address, unfortunately, is not furnished. There were charges for such items as a fish-spit, larding pins, copper pudding boilers and patty pans, basting ladles, bread graters, beer pots, and picture hooks. Furnishings for the fireplace include a "copper scuttle, 21*s.*; one pair of steel tongues, 25*s.*; and one pair bow-spring tongues with stay, 2*s.*" You will recognise the last description as referring to those handy little instruments which are always open, but cannot spread too wide for a hand's grip, because of the pin from one member through the other.

Mrs. Knight was a patron of her sex in business. There were frequent entries relating to the bills of one Lucy Bayles, who owned a furnishing establishment. There was an account for £116 in 1731, which was largely accounted for by an entry for "Three very fine mahogany bookcases with large glass dores, ye mouldings carved, good locks and brasswork, £81." Apparently the lady furnisher did not stock cabinet brass-foundry, because elsewhere her accounts read: "Paid for locks, hinges and brass buttons 5*s.* 8*d.*" Mrs. Lucy Bayles's handyman was one "hary," who, judging from the jobs he took in hand, must have been a good all-round workman, and withal an ill-paid one. There could not have been much for the man when the mistress was satisfied with 2*s.* 4*d.* for eight hours' work and 3*s.* 4*d.* for a whole day's jobbing at Mrs. Knight's house. Mistress Bayles had no more scruples about trespassing on other people's preserves than the toy-shop owners. She competed, for instance, with the apothecary when she charged her customer half-a-crown for half-a-pint of Daffy's Elixir.

Other little glimpses into shopkeeping in the first half of the century occur in these accounts. There was a Mr. John Browne, a silversmith, but not above doing repairs to anything that was brought to him. A coffee-pot, entered as 30 ozs. 5 dwts. at 7*s.* 6*d.*, £11 6*s.* 10*d.*, must have been silver, but a "tea-kettle lamp and stand, polished, 5*s.* 6*d.*," would have been of a baser metal. Browne undertook cutlery repairs and charged 3*s.* 6*d.* for two penknife blades and sixpence for "two pairs of sisers ground," and a shilling for setting two razors. The toy-shop element occurs with such items as blacklead pencils, which cost twopence apiece, a pocket-book priced at 17*s.*, pens, ink and paper, a travelling trunk, china cups, a flint bottle and brushes.

When repairs were required in what are now called, by the estate agents, the offices they were entrusted to another class of tradesman. A Mr. Philip Spood was paid 4*s.* for cleaning and mending "Ye jack and new centering ye worm and oylying ye wheels and pulleys." The same man had 2*s.* 6*d.* for some repairs to

the casements, 8*d*. for putting a foot on the tea-kettle trivet, and 6*s*. 6*d*. for a new strong-box to hold "ye flambeaus," while for "facing two cast smoothing irons and a wrought smoothing iron 4*s*. 6*d*."

Spood was evidently a jobbing workman, because he was not ordered to supply the new jack when Dover Street was beautified. In a long account, chiefly for carpets, curtains, and fabrics, one John Cox—a sort of Maple, I take it—included £6 3*s*. for "one large jack with a multiplying wheel, pulleys, line, and two chains"; but it seems clear Mr. Cox did not fix it, for an earlier item in the account runs, "paid a smith to take down and clean a large jack, 10*s*."

Defoe on Distributors.

One other glimpse of these methods of distributing wares made in London and other centres is afforded by Defoe in his account of a tour through East Anglia. The author of "Robinson Crusoe" mentions a fair at Bury St. Edmunds in 1722 "for diversion more than for trade," a "fair for toys and trinkets," but when he came to Cambridge he wrote of Cheapside and several other streets in Stourbridge Fair which was "kept in a large cornfield near Casterton, extending from the side of the River Cam towards the road for about half-a-mile." The space is still unbuilt upon. Cheapside is no longer the chief street in what remains of the fair, where the only street that has kept its name is Oyster House Row. One evening in June this year I came up the road from the River Cam and tried to visualise the scene, but the glory of the Fair, which old Cambridge pronounces "Sturbidge," has departed. The cornfield is now a dreary waste and no longer the venue of "all sorts of trades, who sell by retail and who come from London with their goods . . . toy-shops, braziers, turners, and pewterers." I have omitted some, but you may take Defoe's word for it that there were present "all trades that can be named in London."

DISCUSSION.

The Chairman (Professor William Gowland, F.R.S., F.I.C., F.S.A.), in opening the discussion, said that, as described by Mr. Young, and as was well known to most of the audience, the conditions under which metalworkers of the eighteenth century carried on their work differed greatly from those which prevailed at the present time. Rolling mills and steam-hammers had not displaced the tilt hammer and the water-wheel. Again, there were no machine tools or self-cutting lathes, or automatic tools of any description. So that there was the disadvantage that the output of a given workshop was only very limited. But, on the other hand, the conditions were not always disadvantageous, because they led to a development of special skill and ingenuity in the individual worker which was not always found at the present day. With regard to water-wheels and tilt hammers, they had had their day; they had been long on their death-beds, but they were by no means yet dead. About seven years ago he visited Vulpmes, a very famous old iron centre near Innsbruck, and there he found in every forge—and there were a great many, not less than forty or fifty in the town—the water-mill and the tilt hammer still in very vigorous and satisfactory work. One curious thing about the work was that in the old days Vulpmes was a famous iron-smelting centre, but that had been given up because they found it was cheaper to buy Bessemer steel from a new works which had been erected a short time before in Styria. So there were these very old appliances, working into sickles and into plates and sheets and the like, one of the latest forms of the metal iron. As was well known, in forging a piece of metal it was necessary that the blows should not all be delivered with the same rapidity. At certain stages of the operation the blows had to be slow and at others quick. That was effected at Vulpmes in a very simple and ingenious way. The man who was doing the forging sat in front of the hammer, and with one hand he manipulated the forging and in the other he held a cord, which was connected with the sluice of the water-wheel. When the man wished the blows to be quick, he opened the sluice, the water-wheel revolved at a greater rate, and so he was able to regulate his work quite as satisfactorily and perfectly as could be done with any modern mechanical appliance. With regard to the materials which were used by the metalworkers of the eighteenth century, he thought it was acknowledged generally that the wrought-iron work of that century exhibited a marked decadence compared with that of the previous centuries, and he thought it was also generally admitted that unfortunately from about the fifteenth century the English smith seemed gradually to have lost the foremost place which he had previously occupied. In cast-iron there were few examples of note in the eighteenth century. The fire-backs of the Sussex and other foundries had been given up owing to the introduction of the hob-grate. Then the founders did not seem to have turned their attention, except but rarely, to anything but the making of ordinary castings—kettles, pots, and the like. Yet in Japan in the eighteenth century there was a vast array of articles of domestic ironwork which were ornamented not only by designs in relief but also inlaid with other metals, and it seemed very curious that in Japan and in this country during that same century there should be such a different class of cast-iron work. The cast-iron work in Japan, more particularly the relief work, was extremely sharp in detail of design owing to all the castings

having been made by the *cire perdu* process, and by using a fusible metal and pouring it into moulds which had previously been heated almost to redness. About the middle of the eighteenth century there was a very important invention made by Réaumur. When a casting was taken from a mould the surface was hard and brittle, and could not be chased or easily worked with any tool. By Réaumur's invention of malleable cast-iron, which he obtained by embedding castings in ferric oxide and exposing them to a considerable heat for a definite period of time, the surface of the metal became soft and available for any decorative work that could be put on it with a chaser, or by inlaying. Yet the English founders, till long after that invention was made, did not seem to have taken advantage of it, and when they did they only made use of it for the production of castings which were to be used in place of more expensive forgings. There was one point with regard to Japanese ironwork which he would like to bring to the notice of the audience, and that was that a Japanese iron article was never polished with sand-paper, or with polishing materials such as were used in this country. During the operations of making it, it was coated with a rich brown permanent rust, so that the object only required to be rubbed from time to time with a silk or a woollen cloth. That rusting was performed in a very simple manner. The article, a kettle for instance, was heated over a brasier, and when it had reached the proper temperature it was then rubbed with a liquid consisting of plum vinegar with iron in solution and containing iron oxide in suspension; and the rubbing was continued until the required depth of the incrustation of rust had been attained. With regard to pewter, pewter of the eighteenth century consisted usually of an alloy of lead and tin, but sometimes of tin to which a small quantity of copper had been added. That alloy pewter, especially the tin-lead alloy, was of very ancient origin. It was in extensive use by the Romans during their occupation of this country, and many examples of it had been dug up on the sites of Roman cities. Many of those he had analysed, and several he had found to have precisely the same composition as the best English pewter; that was, 80 parts of tin and 20 of lead, so that it would be seen that pewter was in use very early in our era. Our pewter, as he had said, consisted of 80 parts of tin and 20 of lead, but just after the end of the eighteenth century there was a very elaborate investigation undertaken by the French Government, and the result was that it was found and really definitely determined that 18 per cent. of lead should be the maximum which should be permitted in all pewter which was intended for the manufacture of vessels for domestic use, in order that liquids which were kept in those vessels should not become contaminated with lead and hence be poisonous. Of course, it was just possible that in France, where sour wines were kept in pewter, it was necessary to have that low percentage of lead, but he had not met with any case of poisoning from liquids which had been kept in our own pewter. There was a very interesting explanation why pewter should be poisonous, which he had found in an old Chinese book on metallurgy. The author said: "It is well known that arsenic under the influence of the feminine principle of Nature in the lapse of ages becomes converted into tin. Hence the pewter which was used in the manufacture of those vessels which were poisonous had consisted partly of arsenic and partly of tin, sufficient time not having elapsed for the conversion of the former into the latter metal." With regard to brass, brass was an alloy of copper and zinc, and brass we owed to the Romans, who made it during the reign of Augustus just at the beginning of our era. Zinc as a distinct metal was not known then; in fact, zinc as a distinct metal was not known in Europe until the sixteenth century, and was never used, even experimentally, in the manufacture of brass until about the beginning of the nineteenth. The Romans discovered that by melting copper with a certain ore—that was calamine—that a golden-yellow alloy brass was obtained. So effective was that method that it survived long after Roman times, and in fact until about 100 years ago it was the only method by which brass was made in Europe. With regard to bells, he was very interested to hear that in England bells were cast in the churchyard or in the neighbourhood of a church. That had been the practice from probably about the tenth or eleventh century in Japan, and there it was almost necessary, because those old bells of Japan weighed from forty to fifty-six tons.

Mr. John Slater, F.R.I.B.A., said the direction which the paper had taken was not quite what he had expected from the title. He thought the author was going to refer more to the eighteenth-century metalwork in railings and grilles, and that sort of thing. He was quite sure everyone present must have been extremely pleased to see a picture on the screen of the beautiful iron railing outside the house in Great Ormond Street. London and Liverpool were very rich in railings of that sort.

Sir Henry Trueman Wood said, as one who had made a study of the history of inventions, especially those of the eighteenth century, he desired to bear testimony to the extreme interest of the paper. It might sound a little conceited for him to say so, but he had found in the lecture a good deal which was new to him, and had found practically nothing which required correction. In considering the places where iron was made, it must be remembered that not only a source of power was required, but also a source of fuel. There was not much doubt that cutlery was first made in Sheffield not only because of the water power available, but on account of the forests which used to be

there, although they had disappeared before the eighteenth century. With regard to the picture thrown on the screen of the way in which the bellows worked, that was an artist's picture of a mechanical invention, and an artist's picture of any mechanical work was always below contempt; it might be beautiful but it was never accurate. The shaft evidently worked the pistons or rods which actuated the bellows by a series of tappets, which forced down the bellows and drove the air out, but there was nothing to indicate how the bellows were raised. With regard to the other picture in which the rod working the bellows was actuated by a cam, and which the author did not seem to appreciate, it was simply that the artist did not know what a cam was; he had made it circular, and a concentric circular cam would have no effect at all. It might be interesting if he mentioned that when the steam-engine was first used to drive bellows, the way it was operated was that it was set to pump water up. The water was then used to drive a water-wheel, and the motion was communicated from the water-wheel by suitable gearing of some sort to the bellows. That seemed rather curious, because a reciprocating motion was first turned into a circular one, and then turned back into a reciprocating motion again. When real blowing engines were first made, he thought they were worked direct from the pistons of the steam-engines. Reference had been made in the paper to Yarranton, a most remarkable engineer, projector, and author. He was really the first man who had made good tin plate in England by going over to Germany and finding out how the Germans made their plate by rolling. The old tin plate in England had been made by hammering, by which method as good plates could not be obtained as by the rolling method. Yarranton did not profit much by his invention, because somebody else slipped in and obtained a patent. With regard to bells, what the Chairman had said was very interesting, because it showed that where the same conditions existed the same means had to be adopted of meeting them. It was not only in Japan that bells could not be carried about; in England, before the days of railways and canals, they could not be transported from one place to another, and they had to be made where they were going to be rung. He fancied that the London bell-founders had for the most part only small workshops where they cast small wares, and if they got an order for a bell at Canterbury or some other place, they went and cast it in the churchyard. He believed all the big bells in England had been cast in that way. With regard to water-mills, he thought some water-mills could be found in England at the present time which were doing useful work. He knew that the last weaving cloth mill of Bradford, which had been given up only a very few years ago, had had a water-wheel, which had originally been the reason for the establishment of the mill there, and it was at work not many years ago. He had tried to find out the origin of windmills, and he had utterly failed. It was certain the Romans used water-mills, and he remembered some reference in a Latin author to mills, which, like the water-wheel, were driven by wind; so they were pretty old.

The Author, in reply, said with regard to Mr. John Slater's remarks, Mr. J. Starkie Gardner had already given a lecture on ironwork before the Society, and he (the author) would have been trespassing upon that gentleman's ground if he had talked upon things about which he did not know so much instead of the particular side of the matter which he had discussed that evening, about which he had some knowledge. With regard to Roebuck's invention of the engine for blowing, he once had access to some of the Carron papers, and among other things he found was a reference to the pumping of the air into a big cylinder or chamber; it was most vague, and one could not follow it, but among the other sketches which he had of Krupp's works there was a very crude and rough drawing made by Alfred Krupp himself, about 1835, showing bellows and a number of other details, and there was certainly a representation of a pair of big bellows delivering air into some sort of cylinder, from which apparently the air was subsequently drawn for use in the furnace.

On the motion of the Chairman a vote of thanks was accorded to Mr. Young, and the meeting terminated.

BRITISH DYE INDUSTRY.

The Government's scheme for the creation of an aniline dye industry in this country was explained by Lord Moulton to a large gathering of business men from Lancashire, Yorkshire, and adjoining counties in the Manchester Town Hall on December 8th. The Lord Mayor of Manchester, Alderman McCabe, presided.

Lord Moulton said he was not present as a representative of the Government or an advocate of any particular scheme. He was there as one giving advice. When he began to investigate the question he found that England consumed some £2,000,000 worth of dyes, which were essential to industrial products valued at something like £200,000,000 a year, on which at least one and a half million men were dependent. Of dyes of that value barely one-tenth was produced in this country, and stocks were rapidly diminishing. There was only one nation—the Swiss—from whom help could be expected, and he knew that pressure of the most intense kind would be put upon them by Germany to prevent them from giving that help. Firms in this country were manufacturing successfully in spite of German competition, but they could only give a quite inadequate supply.

That was the immediate future. But supposing the war was finished and we emerged politically

free, what position should we step into industrially? The textile industries would step into a slavery to the Germans as absolute as they hoped to put us in in a political and military sense. They would be over-charged for dyes and hampered until the Germans had the capital and works to challenge their very existence. Among the chief causes of the position of this country was the English dislike to study—the failure to prepare intellectually for the task that had to be undertaken. The English, he believed, could do the work as well as the Germans, and in their great works they would find English chemists as efficient as the Germans. Unfortunately the holders of capital in this country had little sympathy with knowledge which they did not themselves possess, and there was no career for the young man who wanted to study. In no other respect was this nation at a disadvantage as compared with Germany. The whole of these dyes could be manufactured in England, if the proper plant were put up and the proper men chosen to guide it, with as great a certainty as a casting was manufactured. There must be a great national effort to create a company, for whose success three conditions would be necessary. It must be large, its loyalty must be beyond doubt, and it must be co-operative, the producer being the consumer and the textile trade, the dyeing trades, and the pigment trades working together to secure these conditions. The company must be under national control.

A resolution approving a national effort was carried unanimously.

PANAMA CANAL TRAFFIC.

The *Canal Record* publishes a review of the traffic carried through the Canal during the first two months since it was opened, August 15th to October 15th. In this period the commercial vessels which have been using it have carried through 583,949 tons of cargo. The traffic has followed fairly well-defined trade routes, and the course of the great majority of vessels may be roughly classed in four great groups.

The heaviest traffic has been between the Atlantic and Pacific coasts of the United States. Manufactured goods of great variety and general merchandise are carried from the Atlantic seaboard, principally from New York, and secondarily from Boston, Philadelphia, and New Orleans, to the principal California and Puget Sound ports; also to Honolulu. On the eastbound voyage these vessels carry chiefly canned fruits, vegetables, and salmon, lumber, grain, sugar, pineapples, and wine. This trade is restricted to vessels of American registry, and nearly all the American vessels which have used the Canal have been engaged in it. During the period of Canal operation 24 vessels have passed through eastbound on this route with 151,290 tons, and 25 westbound with 135,214 tons. These passages, 49 in all, have constituted approximately 44 per cent. of all the 113 passages through the Canal. The total cargo carried on this route, 286,504 tons, has been almost exactly 50 per cent. of all cargo.

A route between the eastern coast of the United States and the west coast of South America has been second in cargo through the Canal. Northbound vessels carry principally nitrates from the fields of Chile, with secondary cargo of raw material products of the western countries of South America, and southbound vessels carry manufactured goods from the United States and Europe. The northbound traffic, passing thirteen vessels with 93,189 tons, through the Canal during the two-month period has considerably exceeded the southbound consisting of three vessels with 18,000 tons and one in ballast.

There has been a marked, though probably seasonal, traffic from the Pacific ports of the United States and southwest Canada to Europe with grain. Ten vessels, each heavily laden, have gone through eastbound, with 71,560 tons, and eight vessels, all of foreign registry, have gone from the Atlantic to the Pacific in ballast, to return on this route with grain. In addition, one vessel, which went through the Canal with 6,000 tons of manufactured goods from Antwerp to Tacoma, is to return with grain.

The fourth great route has been from the Atlantic seaboard of the United States to China and Japan with refined petroleum in bulk and in cases and other petroleum products. Four vessels have gone through in this trade from the Gulf of Mexico with 24,931 tons, and four from Philadelphia and New York with 26,570 tons, an aggregate of 51,501 tons. No vessels have gone in the other direction on this route.

Next to the four principal routes just described, the most notable development has been the coal traffic from the middle Atlantic seaboard of the United States to the Pacific coast of North and South America. Five vessels, four from Norfolk, with 22,535 tons, and one from Baltimore, with 6,000 tons, have carried coal to the upper Pacific, and one vessel from Baltimore has carried 6,010 tons to Valparaiso. The total coal carried has been 34,545 tons. None of these vessels have returned through the Canal to this time, but it is understood they will load with Pacific coast products for the eastern United States and for Europe.

The development of a line from Liverpool around South America, with vessels sailing both ways *viâ* the Canal, has been arrested by the European war. The only vessel which used the Canal in this route was the steamship *Potosi*, which passed through the Canal on September 25th, on its way south, along the west coast of South America. It was held in the bay at Balboa, awaiting orders, but sailed on October 14th.

The military service of the United States has used the Canal for the passage of one Army transport and one Navy collier, both from Pacific to Atlantic.

ENGINEERING NOTES.

Latest Developments in Submarine Signalling.—Water has many advantages over air for the purpose of submarine signalling. There is less absorption in water, and consequently the signal is not only more reliable, but is transmitted to a distance many times greater than when it is transmitted through air. The sound is not carried away in stormy weather, neither is it affected by atmospheric conditions, as is the case with wireless telegraphy. Further, submarine signalling permits of accurate determination of the direction from which the sound is proceeding. The first method employed for producing the sound was through the striking of a bell, and the signals were received by means of a microphone attached to the skin of the ship. The signalling bell on lightships is actuated by compressed air stored in a reservoir. The actuating wheel has projections on which, as the wheel revolves, a number of strokes follow each other, the different intervals being peculiar to certain signal stations, so that the captain of a ship, by counting the strokes of the bell, can determine which lightship he is approaching. In order to cut out water noises and other noises on board ship due to the machinery, it has been found necessary to suspend the receiving microphone in a tank of water. One of these is attached to each side of the bow inside the ship. From each tank wires are run to a change-over switch and telephone receiver. With this arrangement first the starboard and then the port microphone can be connected to the receiver. The captain has only to turn his ship until the sound is heard with equal intensity on each side, to know that the ship is then pointing in the direction from which the sound is coming, and in this way he can take compass bearings of the lightship on which the bell is situated. Less sensational than wireless telegraphy, it may be questioned whether its actual practical utility to the merchant marine has not been greater. A new form of transmitter, which has been finally developed by Professor Fessenden in the United States, is termed an oscillator, and represents an important step forward in the science of navigation. With the object of producing very powerful blows on a diaphragm in very rapid succession, a copper cylinder is caused to vibrate along its own axis by means of a powerful high-frequency alternating current (500 periods per second) in the following manner. The copper cylinder is surrounded by a coil in such a way that the latter forms the primary and the copper tube the secondary of a transformer. When high-frequency alternating currents are passed through, the primary corresponding currents are induced in the copper cylinder, which floats in the air gap of a very powerful magnetic field produced by an electro-magnet. The effect of the alternating currents and the constant magnetic field is to make the copper tube vibrate violently and strike the diaphragm. Telegraphing is accomplished by means of making and breaking the supply of alternating current with an ordinary telegraph key. It is usual to use a submerged microphone and telephone receiver for receiving the signals, but the transmitter or oscillator described above is capable of reversing its function, and can be used as a receiver by connecting a telephone to the primary winding. This type of transmitter was first tested by suspending it in 12 feet of water at the Boston Lightship, and signals were heard with a microphone lowered from a tug 31 miles away. The system has been tried in submarine boats, and proved itself of immense value, demonstrating that a flotilla of submarines so equipped would be able to make a combined attack on an enemy, only one needing to show its periscope in order to direct the others. When the apparatus is used as a telephone, conversation can be carried on at 400 to 500 yards. Captains of vessels could thus talk directly to each other without the medium of a telegraph operator. Among the important uses of this method of submarine signalling are the taking of soundings and the detection of icebergs by means of the echo. Sound travels in water at the rate of 400 feet per second, and instruments have been devised for recording the time taken for the echo of the signal to return after being reflected back from the bottom of the sea, and thus the depth of water can be ascertained. Similarly, signals are reflected back from icebergs, and their presence and direction ascertained on board a ship whilst going at full speed.

Water Power from an Artesian Well.—The utilisation of water power is common in Switzerland and other mountainous countries, where large hydro-electric power-stations have been working for some years. We hear, through the *Electrical Review*, of a unique case at Thayo-mindah, in Queensland, where water power is derived from an artesian bore well and used for generating electricity for the district. The water pressure from the well when shut down is said to be 270 lbs. per square inch, and 190 lbs. when the jet is playing on the Loffel water-wheel. The power which can be thus produced amounts to 27 horse-power. There are twenty-five consumers, and the price charged for lighting is one shilling per week for each lamp. The lamps are 50 candle-power, and as there is no other electric or gas supply in the neighbourhood the tariff may be said to be very reasonable and simple.

The Battleship versus the Submarine.—Armour has made a successful defence against the gun, and the gun is effective against a torpedo attack when delivered by torpedo boats, but the protection of the battleship against the submarine and its torpedo is a problem yet to be solved, as is illustrated by the present war. The modern submarine can approach, fire its torpedoes, and cruise away without coming to the surface, and is, therefore, immune

from gun-fire. As the submarine cannot be successfully attacked even by smaller craft, the battleship must adopt some effective form of defence. The torpedo net cannot be used while under way, as it would probably float up to the surface and would certainly prevent a high speed from being attained. Warship designers have proposed to armour the bottom of the ship, and this seems to be the only solution at present, although the weight of such armour must obviously cause a reduction of speed and armament. It is said that if a modern "Dreadnought" were clothed on the bottom with the necessary armour, and her fullness increased sufficiently to allow her to carry this armour, the only important effect would be to reduce her speed by two knots.

Suez Canal.—Owing to the possibility of the belligerent area during the present war covering the Suez Canal, it may be interesting to note its principal features. The canal is 161 kilometres (87 sea miles, or 100 statute miles) long. The navigable dimensions are now practically twice what they were in 1869, the superficial area having been increased from about 380 to 690 square yards in the ordinary channel, to 880 square yards in the numerous gares or crossing places, the dredging having been so carried out as to exceed the limits originally decided upon. From 1869 to 1875 the canal retained its depth of 26 ft. 3 ins., and its bottom width of 72 ft. throughout its length. The gares were 6¼ miles apart, each gare being about 1,100 yards long. From 1875 to 1884 the first improvements were made in straightening and widening the curves. During 1887–88 the canal was deepened by 20 ins., and the bottom width reduced to 59 ft. This extra depth allowed the transit of vessels with a draught up to 25 ft. 7 ins. From 1888 to 1895 the bottom width was increased to 108 ft. The result has been a diminution in the time of transit, which had already been shortened by the use of electric light at night. Ships could then pass one another at any point in the straight reaches in the canal instead of at the gares only. In 1898, owing to the increased dimensions of ships, larger gares were begun, some twenty in number, at an interval of three miles, each gare having an effective length of 820 yards, with approaches of 328 yards at either side. At the same time the depth of the channel was increased to 29½ ft. At present a draught of 28 ft. is allowed. The work of deepening the canal is steadily proceeding from El Ferdan to Suez, and the bottom width has been increased to 128 ft. The curves are also being improved, and a gare has been made on the small Bitter Lake.

Diesel-engined Warships.—Two ocean-going torpedo-boat destroyers will be shortly launched on the Clyde for the Japanese Government. These vessels are of exceptional engineering interest, because while the main propelling machinery is to consist of an installation of steam turbines, each will also have two Diesel engines of 1,200 horse-power for cruising purposes. The twin turbines will each be of 1,200 horse-power, and when the vessels are running at cruising speeds the twin screws will be driven by the oil engines, which it is understood will operate the propellers by means of solid shafts working inside tubular shafts. The Diesel engines, which are being built at Glasgow, are of the six-cylinder, four-cycle type, and they are designed to give the vessels a speed of from 13 to 14 knots. When the turbines are in use the speed will be about 34 knots. As the *Times* Engineering Supplement points out, the advantage of the oil engines for cruising lies in the great saving of fuel which will be possible, and the rapidity with which the vessels can be got under way. The destroyers are to be named "Kawakaze" and "Urakaze" respectively. There are no doubt further advantages beyond those mentioned above, in such a combination of machinery; for instance, when the boats are in the vicinity of the enemy they could proceed under oil-engine power, and so avoid the chance of betraying their presence, which would hardly be possible if they were emitting smoke from their funnels.

CORRESPONDENCE.

THE TRAINING OF INDUSTRIAL CHEMISTS.

In view of the movement for the advance of English industrial chemistry, may I point out the desirability of those who are thinking of taking up this branch of work undergoing thorough practical training in a laboratory after they have finished their purely scholastic course.

My experience is that whilst the usual school curriculum is admirably adapted for inculcating theoretical knowledge, the absence of a knowledge of the business application of theory often leaves much to be desired, with a consequent waste of time and energy, and I therefore strongly advise would-be technical chemists to undergo a practical course of instruction at the hands of technologists, whose business it is to apply theoretical deductions.

This is now so well understood by chemical manufacturers and others, that many prefer the laboratory-trained man to the mere student, however well he may have passed his examinations and high his degree. I have had B.Sc.'s and D.Sc.'s applying to me for work at the lowest rates of remuneration, whilst my own pupils, without such accomplishments, have at once stepped into excellent posts.

W. J. Dibdin.

OBITUARY.

Alfred Henry Baynes.—Mr. Alfred Henry Baynes died on October 16th at his residence at Northwood, Middlesex. He was born at Wellington, Somerset, in 1838, and educated at Devonshire

College, Bath. At first he was intended for the medical profession, but he was compelled by ill-health to abandon this purpose, and, coming to London, entered the accountancy firm of Messrs. Peto, Brassey and Betts. Sir Morton Peto, then head of the firm, was Treasurer of the Baptist Missionary Society, and at his request Mr. Baynes went to the Mission House to take charge of the accounts. He remained there for seventeen years as accountant, and subsequently, in 1878, he was appointed General Secretary, an office which he continued to hold till 1906. On two occasions he visited India and Ceylon, and it was largely through his instrumentality that the Congo Mission was successfully established.

Besides being an indefatigable worker and a skilful organiser, Mr. Baynes was a man of wide interests. He came of a scholarly family: one of his brothers, Professor Thomas Spencer Baynes, was editor of the ninth edition of the "Encyclopædia Britannica," while another, Canon R. H. Baynes, of Worcester, was the author of several well-known hymns. Mr. Baynes, who had travelled considerably, took a keen interest in geography, and was a Fellow of the Royal Geographical Society. He was also a member of the Royal Society of Arts for over forty years, having been elected in 1873.

GENERAL NOTES.

How to Supplant the Enemy Trade in India.—With reference to the paragraph under this heading which appeared in the last issue of the *Journal*, it is interesting to note that, according to the *Sind Gazette*, the French Consular authorities in India are pointing out to the leading importing firms in India the necessity for carrying the war into the economic field, not only with a view to preventing the pan-Germanic States from carrying on their export trade to any extent through neutral States, but also with a view to maintaining and developing the industries of the Allies, so that the latter may better be enabled to provide themselves with the resources necessary for carrying on to a victorious conclusion the present struggle for existence. The Office National de Commerce Extérieur, 3, Rue Feydeau, Paris, being a branch of the French Ministry of Commerce and Industry, has inaugurated an inquiry into the articles of German and Austro-Hungarian origin which can be replaced by French-made articles. The following list of nineteen classes of manufactures which France might supply is given: Chemical products, dyes, colours, etc.; earthenware, glass, crystal glass; textiles; linen dress materials and manufactured articles; paper and its applications; leather; articles made with hide and skin; furs, prepared or manufactured; gold and silver articles, jewellery, imitation jewellery; watches, clocks, etc.; machinery and mechanical appliances; tools and metal articles; furniture and articles made of wood; musical instruments; coaches, motor-cars, motor-cycles, bicycles; rubber articles; ornamental linen; scientific instruments and apparatus; inlaid work, fans, brushes, toys, etc.

Professional Classes War Relief Council.—An exhibition of arts and crafts and pictures will be held by the Professional Classes War Relief Council at 13, Prince's Gate on December 12th. The exhibition will be in three sections, as follows: (1) Exhibits to be sold for the benefit of the artists themselves. This section includes pictures, leather work, black-and-white sketches, metal work, enamels, art embroidery, etc. Five per cent. of the purchase price will be deducted for the benefit of the funds. (2) Exhibits presented by the artists to be sold for the entire benefit of the funds, and covers the same ground as section 1. (3) Toys and other articles made by professional women in the emergency workrooms. Five per cent. of all articles sold and orders taken to be deducted for the benefit of the funds.

Persian Rose-water and Attar of Roses.—There was a great increase in the export of rose-water from Bushire in the fiscal year 1912-13, 271 tons, against 189 tons in 1911-12. This product is obtained in one small district of Fars, between Bushire and Shiraz, where roses have been famous for many centuries, and there is extensive cultivation. Distillation of the rose petals and the manufacture of rough glass carboys and bottles is a special industry in the district. The total output of rose-water has been estimated at 400 tons, or 10,000 cases, but there is a large consumption in Persia itself. The yield of roses was larger than usual in 1913, but owing to lack of rain a vegetable product, which is used with certain local earths in manufacturing the crude green-glass carboys, was not obtainable in sufficient quantities, and there was a smaller output of rose-water than usual, which will probably be noticeable in the figures for 1913-14, when available. Hitherto there has been no attempt to place a Persian brand of essential oil (attar) of roses on the market in Europe, and the output has been limited to requirements in Persia and India, some 2,500 miskals or 320 ounces annually, but owing to the restricted Bulgarian crop and the favourable opportunity occurring, small experimental consignments were sent to London in 1913. Persian attar has marked qualities of its own, which make it quite different from the Bulgarian product.

The Coal Industry of Japan.—The most important coal district in Japan is the Island of Kyushu. The mines in this district are almost all owned or controlled by a company which, by agreement with its only large competitor, is able to control in large measure the prices asked for coal in Southern Japan. In the Hokkaido coal-fields many fine prospects are being discovered. Karafuto also is said to be rich in coalfields. The noticeable increase in the world's demand for

Japanese coal caused great activity in coal mining circles in 1913. Many new mines were opened up, and seams in old mines were prepared for operations; other seams abandoned as worthless were re-surveyed and profitable seams discovered, while the business of locating new coal outcrops was flourishing. In 1912, 19,638,755 tons of coal were mined throughout Japan; in 1913 this figure was increased to 21,300,000 tons. A heavy rise in the price of coal on the home market, due to the foreign demand, was one of the most disturbing economic problems confronting large manufacturing concerns throughout the year. The quantity of coal exported from Japan in 1912 was 3,440,347 tons, as compared with 3,839,881 tons in 1913. The amount of bunker coal supplied to Japanese and foreign vessels in Japanese ports was 2,471,000 tons in 1912, and 2,676,000 tons in 1913. Cheap Chinese coal is imported to take the place of the high-priced Japanese coals that are exported.

MEETINGS OF THE SOCIETY.

Ordinary Meeting.

Wednesday evening, at 8 o'clock:

December 16. Sir William de Wiveslie Abney, K.C.B., D.C.L., D.Sc., F.R.S., "Testing Pigments for Permanence of Colour." Sir Thomas H. Holdich, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Chairman of the Council, will preside.

Indian Section.

Thursday afternoon, at 4.30 o'clock:-

December 17. Dr. F. Mollwo Perkin, F.I.C., F.C.S., "The Indian Indigo Industry." Sir Steuart Colvin Bayley, G.C.S.I., C.I.E., will preside.

Papers to be read after Christmas:-

F. Vincent Brooks, "British Lithography in 1915."

Hon. John Collier, R.O.I., "Portrait Painting." Lord Sanderson, G.C.B., K.C.M.G., will preside.

Octavius Charles Beale, Chairman of the Australian Manufacturers' Association, "Imperial Industrial Development after the War."

Thomas Worthington, "The Work of the Commercial Intelligence Branch of the Board of Trade."

T. Thorne Baker, "The Industrial Uses of Radium."

Frank Baines, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

E. W. Hulme, "Patent Law."

H. M. Thornton, "The Industrial Uses of Coal Gas."

D. Y. Cameron, A.R.A., R.E., "Etching."

Roger Fry, "Post Impressionism in Design."

C. H. Sherrill, "Ancient Stained Glass."

William Poel, "Shakespeare's Profession."

Arthur Wilcock, "Designing for Textiles."

J. A. Hunter, "The Textile Industries of Great Britain and of Germany."

Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

Edward R. Davson, "Colonial Sugar Development."

Major E. H. M. Leggett, R.E., D.S.O., Managing Director of the British East Africa Corporation, "The Economic Development of British East Africa and Uganda."

Henry John Elwes, F.R.S., "Nepal."

Captain Sir George Duff Dunbar, Bart., I.A., "Tribes of the Brahmaputra Valley."

Lieut.-Colonel A. C. Yate, I.A. (retired), "The Indian Army."

M. M. S. Gubbay, I.C.S., "Indian Trade and the War."

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

January 21, February 18, March 18, April 15, May 13.

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:

February 2, March, 2, 30, May 4.

Cantor Lectures.

Monday evenings, at 8 o'clock:-

R. A. Peddie, Librarian, St. Bride Foundation Typographical Library, "The History and Practice of the Art of Printing." Four Lectures.

Lecture IV.—December 14.—*The later history of colour printing.* Rise of chromo-lithography—Chromo-xylography The three-colour process—Collotype—Photogravure and its combinations—The offset process.

Dr. F. Mollwo Perkin, F.I.C., F.C.S., "Oils, their Production and Manufacture." Three Lectures.

January 18, 25, February 1.

M. H. Baillie Scott, "House Building—Past and Present." Three Lectures.

March 15, 22, 29.

David Sommerville, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

Fothergill Lectures.

Monday evenings, at 8 o'clock:—

Professor Vivian B. Lewes, F.I.C., F.C.S., "Motor Fuel." Three Lectures.

February 15, 22, March 1.

JUVENILE LECTURES.

Wednesday afternoons, at 5 o'clock:—

H. PLUNKET GREENE, "How to Sing a Song." Two lectures, with vocal illustrations.

January 6, 13.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DECEMBER 14...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. R. A. Peddie, "The History and Practice of the Art of Printing." (Lecture IV.)

Victoria Institute, Central Buildings, Westminster, S.W., 4.30 p.m. Mr. E. W. Maunder, "The Principles of World Empire."

Engineers, Cleveland Institution of, Corporation-road, Middlesbrough, 7.30 p.m. Mr. J. H. Whiteley, "A Study of Cast Steel."

Electrical Engineers, Institution of (Newcastle Section), Mining Institute, Newcastle-on-Tyne, 7.30 p.m. Mr. C. J. Beaver, "Cables."

Mechanical Engineers, Institution of, Storey's-gate, Westminster, S.W., 8 p.m. (Graduates' Section.) Mr. C. B. Dicksee, "The Conditions Governing the Power of Petrol Engines."

Surveyors' Institution, 12, Great George-street, S.W., 8 p.m. Messrs. A. Young and L. O. Mathews, "The Report of the Land Enquiry Committee on the Acquisition of Land."

Geographical Society, Burlington-gardens, W., 8.30 p.m. Captain H. A. Edwards, "Frontier Work on the Bolivia-Brazil Boundary."

British Architects, Royal Institute of, 9, Conduit-street, W., 8 p.m. Mr. J. J. Joass, "The Work of the late John Belcher, R.A."

East India Association, Westminster Palace Hotel, S.W., 4 p.m. Colonel D. C. Phillott, "Some of the Military Castes of the Indian Army."

TUESDAY, DECEMBER 15...Statistical Society, 9, Adelphi-terrace, W.C., 5 p.m. 1. Dr. J. C. Dunlop, "A Further Note on the Fertility of Marriage in Scotland. Errors of Statement as to the Duration of Marriage." 2. Mr. D. C. Jones, "Notes on the Census of Occupations."

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 5 p.m. The Earl of Meath, "The Training of the New Armies."

African Society, Hotel Cecil, Strand, W.C., 8 p.m. Address by the Hon. W. P. Schreiner, High Commissioner for the Union of South Africa.

Electrical Engineers, Institution of (Manchester Section), 17, Albert-square, Manchester, 7.30 p.m. Mr. E. B. Wedmore, "Automatic Protective Switch Gear for Alternating-Current Systems."

Civil Engineers, Institution of, Great George-street, S.W., 8 p.m. Discussion on following papers: 1. Mr. J. B. Ball, "Tests of Reinforced-Concrete Structures on the Great Central Railway." 2. Mr. S. H. Ellis, "Corrosion of Steel Wharves at Kowloon." 3. Mr. J. Hammersley-Heenan, "Concreting in Freezing Weather and the Effect of Frost upon Concrete."

British Decorators, Institute of, Painters' Hall, Little Trinity-lane, E.C., 8 p.m. Mr. C. A. Hindley, "Decorators and the Use of Colour."

Anthropological Institute, 50, Great Russell-street, W.C., 8.30 p.m. Mr. C. V. Boyle, "Ethnological Notes on the Lalas of Nigeria."

Engineers and Shipbuilders in Scotland, Institution of, 39, Elmbank-crescent, Glasgow, 8 p.m.

WEDNESDAY, DECEMBER 16...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Sir William Abney, "Testing Pigments for Permanence of Colour."

Meteorological Society, at the Surveyors' Institution, Great George-street, S.W., 7.30 p.m. 1. Mr. W. F. Stacey, "Distribution of Relative Humidity in England and Wales." 2. Mr. A. E. M. Geddes, "Observations of the Upper Atmosphere at Aberdeen by means of Pilot Balloons."

Microscopical Society, 20, Hanover-square, W., 8 p.m. Mr. J. E. Barnard, "X-rays in Relation to Microscopy."

Medicine, Royal Society of, 1, Wimpole-street, W. Section of the History of Medicine, 5 p.m. 1. Dr. G. Peachey, "A Seventeenth Century Medical Superstition." 2. Mr. C. J. S. Thompson, "The Apothecary in England from the Fourteenth to the Sixteenth Century."

Electrical Engineers, Institution of (Birmingham Section), The University, Birmingham, 7.30 p.m. Mr. E. B. Wedmore, "Automatic Protective Switchgear for Alternating-Current Systems."

THURSDAY, DECEMBER 17...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4.30 p.m. (Indian Section.) Dr. F. Mollwo Perkin, "The Indian Indigo Industry."

Petroleum Technologists, Institution of, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Professor J. Cadman, "Notes on the Development of the Trinidad Oilfields."

Royal Society, Burlington House, W., 4.30 p.m.

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Linnean Society, Burlington House, W., 5 p.m. 1. Mr. M. Christy, "'Witches Brooms' caused by the Gall-mite, *Eriophyes triradiatus*, Nal., on *Salix fragilis*." 2. Mr. W. M. Webb, "The Brent Valley Bird Sanctuary: an experiment in bird protection."

Chemical Society, Burlington House, W., 8.30 p.m. 1. Mr. F. Tutin, "Isodibenzoylglucoxylose." 2. Mr. P. C. Ray, "Platini-, mercuri-, and cuprichloromercaptides and tautomerisation of organic thiobodies as brought about through the agency of mercuric, cupric and platinic chlorides."

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Professor W. C. F. Anderson, "Montenegro."

Medicine, Royal Society of, 1, Wimpole-street, W. Section of Dermatology, 5 p.m. Dr. K. Sibley, "Case of Angiokeratoma." Other cases will be shown.

Historical Society, 7, South-square, Gray's Inn, W.C., 5 p.m. Dr. G. W. Prothero, "The Causes of the Anglo-German Hostilities in 1914, from the Historian's Point of View."

Concrete Institute, 296, Vauxhall Bridge-road, S.W., 7.30 p.m. Discussion on Mr. H. K. Dyson's paper, "Shear and Problems arising therefrom."

Mining and Metallurgy, Institution of, at the Geological Society, Burlington House, W., 8 p.m. Mr. T. A. Rickard, "Persistence of Ore in Depth."

FRIDAY, DECEMBER 18...Engineers, Junior Institution of, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 8 p.m. Address by the Marquis of Graham (President), on "The War and Engineering."

Mechanical Engineers, Institution of, Storey's-gate, Westminster, S.W., 8 p.m. Papers by Messrs. W. C. Acfield (Midland Railway), L. P. Lewis (Caledonian Railway), V. L. Raven (North-Eastern Railway), W. A. Stanier (Great Western Railway), and W. Willox (Metropolitan Railway), on "Audible and other Cab Signals on British Railways."

Journal of the Royal Society of Arts.

No. 3,239. VOL. LXIII.

FRIDAY, DECEMBER 18, 1914.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

CANTOR LECTURES.

On Monday evening, December 14th, Mr. R. A. Peddie delivered the fourth and final lecture of his course on "The History and Practice of the Art of Printing."

On the motion of the Chairman a vote of thanks was accorded to Mr. Peddie for his interesting course.

The lectures will be published in the *Journal* during the Christmas recess.

INDIAN SECTION.

Thursday afternoon, December 17th; Sir Steuart Colvin Bayley, G.C.S.I., C.I.E., in the chair. A paper on "The Indian Indigo Industry" was read by Dr. F. Mollwo Perkin, F.I.C., F.C.S.

The paper and discussion will be published in a subsequent number of the *Journal*.

JUVENILE LECTURES.

The usual short course of lectures adapted to a juvenile audience will be delivered on Wednesday afternoons, January 6th and 13th, 1915, at 5 p.m., by Mr. H. Plunket Greene, on "How to Sing a Song."

Special tickets are required for these lectures. They can be obtained on application to the Secretary.

A sufficient number of tickets to fill the room will be issued to Fellows in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions, each Fellow is entitled to a ticket admitting two children and one adult. Fellows who desire tickets are requested to apply for them at once.

COVERS FOR JOURNALS.

For the convenience of Fellows wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1*s*. 6*d*. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

FIFTH ORDINARY MEETING.

Wednesday, December 16th, 1914; Colonel Sir Thomas H. Holdich, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Vice-President and Chairman of the Council of the Society, in the chair.

The following candidate was proposed for election as a Fellow of the Society:—

Soule, President Andrew McNairn. Sc.D., Ph.D., State College of Agriculture, Athens, Georgia, U.S.A.

The following candidates were balloted for and duly elected Fellows of the Society:—

Smith, Rev. Professor Samuel George, D.D., LL.D., Ph.D., St. Paul, Minnesota, U.S.A.

Tyrer, Thomas, F.I.C., F.C.S., 14, Sandwell Mansions, West End-lane, N.W.

The Chairman said there was no need for him to introduce such a distinguished member of the Society as Sir William Abney. Sir William had read many papers before the Society. As an expert in all matters connected with colour, whether in relation to photography or to other forms of art, Sir William's reputation was world-wide. He (the Chairman) remembered that some years ago the matter of testing pigments for their permanence and colour was the subject of some amount of agitation amongst artists, and experiments were made then, principally, he thought, by Sir William himself; but the conclusions formed at that time were not absolutely accepted, and since then further experiments had been carried out by the author, and it was with regard to those particularly that Sir William was going to address the members that evening.

The paper read was—

TESTING PIGMENTS FOR PERMANENCE OF COLOUR.

By Sir William de W. Abney, K.C.B., D.C.L., D.Sc., F.R.S.

It is some twenty-eight years since the late Dr. W. J. Russell, F.R.S., and myself were asked by the chiefs of the Science and Art

Department to investigate the causes of the fading of water-colour drawings when exposed to light. There were, and are, in the Victoria and Albert Museum collection of water-colours many samples of the injurious effects which exposure to light have had on them.

Soon after we started our investigations the press announced that such an inquiry was under way, and a resolution from the Royal Society of Painters in Water Colours was then sent to the Science and Art Department, urging "the desirability, in the interests of water-colour painters, of the appointment of a water-colour painter in association with Dr. Russell and Captain Abney in the work of investigating the effect of light of various colours upon water-colour pigments." This resolution was considered, and the Department requested the Royal Water Colour Society and the Royal Institute of Painters each to appoint two members to a committee which it proposed to form with a view that we should keep such a committee informed as to the methods of investigation we were adopting. "The committee, with this information before them, would be in a position to judge whether there were any further points they would desire to suggest for investigation, or whether there is any investigation which the committee would themselves wish to carry out."

The committee appointed was as follows:—Sir F. Leighton, P.R.A., chairman, Mr. L. Alma Tadema, R.A., Mr. T. Armstrong, Mr. Sidney Colvin, Mr. Frank Dillon, Mr. Carl Haag, Sir James D. Linton, Mr. E. J. Poynter, R.A., and Mr. Henry Wallis, with Mr. Arthur Torrens as secretary. The scheme that we had thought out was submitted to the committee and unanimously approved, and they did not propose any investigation of their own. For nearly three years we continued our experiments, and in June, 1888, we made a report of which the above-named committee also approved. This was issued as a Parliamentary paper to both Houses of Parliament. A certain number of reviews and various letters appeared in the press on the subject of the report. The criticisms were mostly of a kindly nature. The facts brought out by the results of our numerous and tolerably exhaustive experiments were not questioned. In one or two cases our interpretation of them was criticised. After a month or two our investigation did not call forth much further notice, and, like the fate of most Parliamentary reports, it remained to a great extent unheeded, except, perhaps, by artist colourmen. Another unofficial committee was formed by some persons interested in the subject of Fading, and the results of their experiments were published from time to time. If I remember rightly, they in no ways impugned the results of our experiments.

There are so many colours in an artist colourman's list that the trial as to the stability of all of them would have increased the number of experiments manyfold. To enable us to judge which were the most necessary to proceed with, the Science and Art Department obtained from forty-five of the principal water-colour artists lists of the colours which they individually employed. From these lists we selected the pigment colours, the stability to light of which we concluded ought to be investigated.

Twenty-five years have passed, and I shall not be guilty of indiscretion if I say that we found that nearly all the forty-five were using one or more of what may be called fugitive colours. It would have been interesting if a year after our report had been issued we could have had fresh lists before us of the pigments they then severally used, to see what changes had been made. Some, no doubt, would have thought as one artist did, who argued that whilst some of A's colours had been proved to fade, yet all of B's were quite safe. Almost a new generation of artists is living now, and as artists are not as a rule given to reading scientific works, it is quite possible that the report on the fading of water-colours may be unknown to them, especially as it is "buried" as a Parliamentary paper. It is for this reason that I wish, in a way, to revive if possible the interest in the subject by bringing it before the Royal Society of Arts, and to explain a method of testing any pigment for fading in a short time, instead of having to wait for a year or two before results could be obtained. There are various new water-colour pigments placed before the public from time to time, and it is these which require a simple test.

In reference to the younger generation of water-colour artists, I may say that even older painters sometimes require information.

It was not very long ago that on arrival at a certain foreign capital I paid a visit to an artist friend whose drawings are well known and appreciated in Europe and America. On my arrival I was shown up to the studio and found my friend for the moment the picture of despair. He was extracting pictures from a packing-case which had been returned from another capital after being exhibited for a couple of months the previous autumn.

He pointed out to me that a whole series of those which had been hung near the skylight of the exhibition room had lost colour in parts. Their freshness had gone, though they were still beautiful works of art. Questioning him as to what colour had faded, I found that it was vandyke brown, which he used to give tone to some of his delicate colour-washes. He only knew me as an amateur painter, and was unaware that the question of the fading of colours had been one of my hobbies. I told him the result of our experiments, and furnished him with a copy of our report. On a subsequent visit I found him radiant once more, having obtained a substitute for his vandyke brown which was permanent. I may say that he grieved principally over the fact that his clients had pictures of his which might behave or have behaved as those did which were exhibited.

My friend being a foreigner, I could not blame him for being unacquainted with our experiments on safe colours. Nearer home I have found published a list of colours used by a very celebrated artist. That list contains the names of some which he should have placed on the "black list." One has to imagine what may be said of his pictures by his clients in a few years to come. I have often inquired of my numerous artist acquaintances as to the composition of the palette they use, and in not a few cases have I given warning as to colours which ought not to be used. [I should recommend to any one who cannot paint, but thinks he can, to use every colour which is not "safe," as the productions will eventually find their way into the wastepaper basket.]

I trust I may be allowed to recapitulate briefly the conditions most favourable for the fading of pigments, and those under which the fading of some of them is highly, to say the least, improbable to occur.

Speaking generally, every pigment absorbs or abstracts rays of the spectrum which it does not reflect, and it is the collection of the reflected coloured rays that gives the colour of the pigment. Each particle of a pigment is composed of a very large number of molecules, and these molecules are formed of several atoms, held together by attraction to one another. The rays of light absorbed by the pigment may by their vibratory motion shake away from the molecules one or more of the atoms, decomposing the molecules, and thus change the particles of the pigment. This change in composition is shown as fading. Like the silver salts in photography if a body is in contact with the pigment, which can take up the atoms of the shaken-off molecules greedily, then the fading in a given time will become more rapid. Such a body is found in the moisture in the air, so that a damp pigment fades more readily than a dry pigment. In the case where the atoms of the pigment, even with moisture present, refuse to be removed from the molecule, there is no fading.

It was owing to observations on the salts of silver, which behaved as just described, that our experiments on pigments were started. There is always moisture in the atmosphere, so that if a pigment is exposed to light under ordinary atmospheric conditions it is liable to fade; if it will fade at all the fading will show itself eventually. In our experiments the light employed was sunlight and skylight. The pigments exposed had various depths of colour, No. 1 being the lightest and No. 8 the darkest.

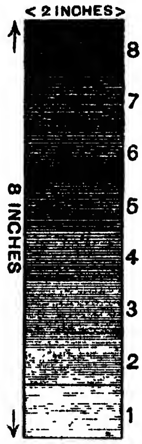

FIG. 1.

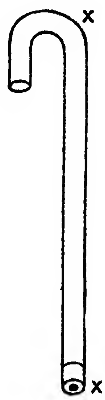

FIG. 2.

Half of the paper washed with the varying shades of colour was covered up with black paper, and the light had free access to the other half. The papers were exposed in glass tubes bent over at one end to form a hook. There was a perpetual change of air in the tubes.

The annexed table shows the pigments which were exposed to light in these tubes, and the results of the exposure. The last thirteen showed no signs of fading. The first thirteen are really unstable, and the whole list is placed approximately in the order of instability. The next thirteen are much less unstable:—

Colour.	Composition according to Winsor and Newton.
Carmine . . .	Lake prepared from cochineal.
Crimson lake .	Lake prepared from cochineal.
Purple madder .	Lake prepared from madder root.

Colour.	Composition according to Winsor and Newton.
*Scarlet lake.	Lake prepared from vermilion and crimson lake.
†Payne's grey	Indigo crimson-lake and carbon black.
Naples yellow	Mixture of zinc white and cadmium yellow.
Olive green	Quercitron lake, bone brown, and ultramarine.
Indigo	Extract from the indigo plant.
Brown madder	Lake prepared from madder root.
Gamboge	A preparation of gum resin.
Vandyke brown	Native earth prepared for painting.
Brown pink	Lake made from quercitron bark.
Indian yellow	Prepared "purree" from India.
Cadmium yellow	Sulphide of cadmium.
Leitches blue	Mixture of Prussian blue and cobalt.
Violet carmine	Lake obtained from root of anchusa.
Purple carmine	Lake obtained from root of tinctoria.
Sepia	From the cuttlefish bags.
Aureolin	Double nitrite of cobalt and potassium.
Rose madder	A lake from the madder root.
Permanent blue	A pale variety of French ultramarine.
Antwerp blue	Prussian blue and alumina.
Madder lake	Same as rose madder.
Vermilion	Mercuric sulphide.
Emerald green	Aceto-arsenate of copper.
Burnt umber	Calcined raw umber.
Yellow ochre	Native earth.
Indian red	A variety of iron oxide.
Venetian red	Artificially prepared sesqui-oxide of iron.
Burnt sienna	Calcined raw sienna.
Chrome yellow	Normal chromate of lead.
Lemon yellow	Chromate of barium.
Raw sienna	Native earth.
Terra verte	Native earth.
Chromium oxide	Chromium sesquioxide.
Prussian blue	Ferro-cyanide of iron.
Cobalt	Alumina tinctured with cobalt oxide.
French blue	Artificial ultramarine.
Ultramarine ash	Extract of lapus lazuli.

Looking at the composition of the last thirteen permanent colours we cannot fail to notice that they are all native earths or oxides of metals, with one or two exceptions. In fact, all have a mineral basis, whilst the remainder of the list which have the most tendency to fade are mostly organic derivatives.

* Scarlet lake more recently prepared is now made from vermilion and alizurin crimson.

† Payne's grey is now made from carbon black ochre and French ultramarine. Both Payne's grey and scarlet lake should now be much more permanent.

It must be recollected that the light used in obtaining these results was of the most intense nature, and not that to which ordinarily water-colour paintings would be exposed.

The second thirteen colours are probably colours which would not fade in any ordinary light. It must, however, be remarked that when mixtures of colours are employed those colours which are more or less fugitive have a greater tendency to fade than when tested alone. For instance, in a mixture of indigo and Indian red the indigo fades more easily than the indigo does when unmixed. Russell and myself proved this by experimenting with thirty-four mixtures, such as were often used by artists.

The case which I mentioned of the rapid fading of vandyke brown in the light from the sky was probably due to the vandyke brown being used mixed with other colours.

It may be as well to state here we found experimentally that practically every coloured pigment exposed to light *in vacuo* declines to fade, and the same may also be said of pigments exposed in perfectly dry air or oxygen, a condition which is non-existent in the atmosphere in which pictures are exposed to light. The presence of moisture is always required to effect a change in colour, and we also found that the bluer the light to which colours are exposed the more rapidly, in most cases, will the fading take place.

A reference must here be made to the effect of the light from the sky on pigments exposed for nearly two years in a frame in a window with north light. The following colours were in the frame:—

Antwerp blue	Prussian blue and vandyke brown
Prussian "	Prussian blue and gamboge
Leitches "	Prussian blue and Indian red
Indigo	Indigo and vandyke brown
Gamboge	Indigo and burnt sienna
Brown pink	Indigo and Indian red
Indian yellow	Rose madder and raw sienna
Naples "	Antwerp blue and raw sienna
Lemon "	Vermilion and chrome yellow
Vandyke brown	
Venetian red	
Crimson lake	
Vermilion	
Rose madder	
Carmine	
Prussian blue and burnt sienna	

Our report on the effects of this moderate daylight was as follows:—

Of the single colours, gamboge, indigo and Naples yellow had slightly faded; brown pink

had faded perceptibly to 6 (the deepest shade but 2); carmine had *bleached* to 3; vandyke brown had faded to 1 and was fainter to 4; and crimson lake had faded to 5; and all the darker shades had become paler. In mixtures one of Prussian blue and burnt sienna that had changed, the blue had faded. With Prussian blue and vandyke brown, and with indigo and vandyke brown, the vandyke brown had faded. With Prussian blue and gamboge, the gamboge had slightly gone in No. 1 and all shades had become browner. With indigo and gamboge, all the shades had become paler throughout. With indigo and Indian red the indigo in No. 1 had gone entirely and partly in all tints. The other colours both single and mixed, had not changed.

This experiment confirms the results which had taken place in strong light. We may, therefore, take it that the list of fugitive and stable colours we have given is the same in feebler light as it was in sunlight. From the permanent thirteen colours we have given, and from the thirteen semi-fugitive colours, we can form a good gamut for the water-colour artist.

Various artifices from time to time have been proposed for preventing the fading of pictures in light. A novel and effective one theoretically was to make the frame into a vacuum chamber. But so far as I know there were practical difficulties existing which prevented its general adoption. Recently a glass has been proposed which is said to prevent chemically the active rays from reaching the picture. I have roughly and not exhaustively tried a specimen of this glass, and exposed fugitive pigments beneath it to light this autumn. I have not found that it prevented the fading of the colours I tried, and I should hesitate to adopt it myself. But I hope that others will try its effect. If it is proved efficient it would be a great boon, and the list of fugitive colours might then be of no use. I have said that the blue light (which includes the violet) is that which is most chemically active. I found that if a skylight was glazed with signal-green glass and an orange in right proportions to make a white light by their mixture, the colours of pigments appeared as in ordinary white light and the chemically active rays were cut off. The committee I mentioned in my paper satisfied themselves that such was the case and the Raphael cartoon gallery was so glazed. The public seemed unaware of the peculiar mode of glazing.

May I be allowed to become a little personal for the moment? Having studied the theory of colours from a scientific point of view for more years than I like to remember, when I retired from the Civil Service some eleven years ago I took to painting in water-colours as an occupation. Naturally I endeavoured to get a gamut of colours which should be sufficient in their range and at the same time as permanent as possible. My colour-box now consists of:—

Vermilion	Cobalt
Light red	French blue
Rose madder	Antwerp blue
	Cyanin blue
Aureolin	Violet cobalt
Yellow ochre	
Raw sienna	(An imitation and permanent) vandyke brown
Cadmium yellow	
Madder ,,	(An imitation and quasi-permanent) brown madder
Lemon ,,	
	Turner's brown
Emerald green	Burnt sienna
Viridian	Neutral tint (from my own formula)
Hooker's green (A new mixture)	
Sunny green	Ivory black

All these colours are either in the list of the thirteen permanent colours, or come near them in the next thirteen. None of the colours is in the first thirteen, which, as already said, I class as fugitive colours.

Before adopting these colours I was anxious to see how the mixtures imitating colours with known names would stand the light. A year or two after the report had been published I determined to try if a short cut could not be found to test the permanency of any colour. Some experiments I had made with certain photographically-produced colours led me to think that the action of light on pigments in the presence of moisture might be a secondary action, and that the fading might be due to the formation of some oxidising agent produced by the light on moisture in the presence of oxygen. It had been proved in our report that the exclusion of all air from the colour prevented fading, and that colours did not fade when *dry* oxygen was in contact with them, and that only when there was the addition of moisture did the fugitive colours fade. It appeared to me that if oxygen were ozonised in the presence of moisture, the action might be the same as when light was acting with no added ozone present: in other words, that light itself tended to produce an ozonised atmosphere in the presence of moisture and that it was this which caused the fading.

To test this, strips of the same colours as those which were exposed to the light were moistened and placed in a tube, through which ozonised oxygen was passed in a slow current. The oxygen was ozonised by an ozone tube connected with a coil. As I anticipated, there was a fading of those colours which were affected by light. I have already given the list of single colours which were tried, in their order

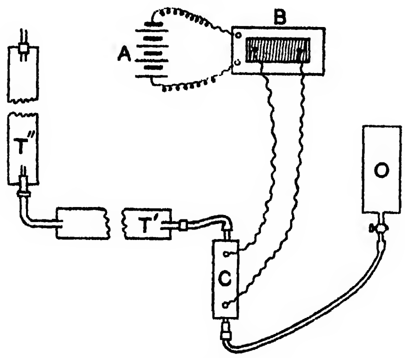

Fig. 3.

of "light" stability. Practically this same list is here repeated in the following table, but it also shows the times of exposure to the ozone current which were required to cause fading or destruction of those colours which light had been able to alter. The times given as necessary for ozone to act are approximately the relative sensitiveness to fading by the method described.

Pigments in the order of fadings by light	Time of exposure to fade in damp ozonized air.	
	h.	m.
Carmine	0	10
Crimson lake	0	30
Purple madder	0	20
Payne's grey	1	0
Naples yellow	0	45
Olive green	1	5
Indigo	0	40
Brown madder	2	10
Gamboge	0	50
Vandyke brown	1	15
Brown pink	0	30
Indian yellow	4	0
Cadmium yellow	4	0
Violet carmine	4	0
Aureolin	Unchanged.	
Rose madder	4	0
Permanent blue	3	30
Vermilion	Unchanged.	
Emerald green	0	45

Pigments in the order of fadings by light.	Time of exposure to fade in damp ozonized air.	
	h.	m.
Yellow ochre	Unchanged.	
Indian red	,,	
Venetian red	,,	
Burnt sienna	,,	
Chrome yellow	,,	
Raw sienna	,,	
Terra verte	,,	
Chromium oxide	,,	
Cobalt	,,	
French blue	3	30
Ultramarine ash	Unchanged.	

The same colours were exposed to dry ozonised oxygen, all moisture being excluded. The paper and pigment were carefully dried, and the oxygen had to bubble through a series of bulbs containing strong sulphuric acid, to absorb any moisture which might have been in the oxygen. In no case did the dry ozonised oxygen have any action on the pigments. The most fugitive came out of the exposure-tubes unaltered.

This, be it remembered, was the same when the exposure to light took place in dry oxygen. The pigments remained unchanged.

This experiment proved that unless moisture were present with the ozonised oxygen the test did not work.

It will be noticed that eleven of the first thirteen colours which in our list showed no change under the influence of light, were taken, and only one of them, French blue, showed any change under the influence of ozonised oxygen and moisture, and that was very small. Of the other twenty-six colours only twenty-three were experimented with, and all of them showed an alteration. Of the second thirteen in the list, seven were tried and all proved to be fairly stable colours, aureolin and vermilion, which under the action of light blackened, showed no deterioration; the others, after an exposure to the ozone, showed slight deterioration after about four hours. Of the thirteen most fugitive colours in the list, scarlet lake was omitted. Brown madder and Indian yellow appeared more stable than they did when exposed to light, the remainder followed very fairly the order of fugitiveness given in the list.

Mixtures faded under the influence of damp ozone more rapidly as a rule than did the fugitive colours by themselves. Where one of the colours was stable the fugitive colour completely disappeared, and where both were fugitive—as, for instance, a mixture of indigo and gamboge—both disappeared.

It might be thought that peroxide of hydrogen, which is used for altering the colour of

hair and for other purposes, might be a substitute for the ozone treatment. So far I have found it quite inoperative in regard to pigments such as have been tested.

Returning for an instant to my own water-colour box, I show the results of the ozone treatment. The only case where any fading has taken place in any of the colours is that of rose madder, which had a most prolonged exposure. It will be noticed that where I have replaced a colour by a mixture having the same tint (*e.g.*, Hooker's green, made of Prussian blue and aureolin), the colour is a stable one, since both the mixing colours are stable. I have brought a few of the really unstable washes to show you, and you can judge of the effect of the ozonised damp air upon them.

With oil paints the ozone test has so far, with me, been unsuccessful. The ozone seems to attack the medium, as the colour is so successfully locked up in it that very little effect is produced, even with the most fugitive colours. This is not what takes place when light acts on oil colours, for in a series of experiments (not yet published) made with them the same final results were obtained as with water-colours.

So far I have confined myself to water-colour washes, but the same method of experiment gives an answer at once as to whether a wallpaper will remain unaffected by light.

In my own house I have unfortunately had wallpapers which looked pretty and well suited to the rooms, but in the course of two or three years all the prettiness had gone, though a pattern remained. Of some of these papers I had spare rolls, and I tested them with the ozone treatment, and found that it gave the same class of fading as that which the exposure to light had given.

It is quite easy to diagnose whether a wallpaper will stand the light, and I always try and test them before I make a final choice. It is in the delicate tints that fading takes place. Where a paper is heavily coated with a pigment which, when applied more thinly, will fade, it may stand the light for a considerable time before being found out. I show numerous kinds of wallpapers which have been submitted to the test. In some cases the fading is slight but quite marked; in others the fading is much more marked, more especially with certain kinds of papers which have a green tint in them. In a good many cases the papers have been on walls of a room, and the fading is similar to that caused by the ozone.

The test for permanence of colour can be applied to ladies' dresses. Summer dresses are very often of beautifully delicate shades, and have parasols to match the dresses. A few inches of the material of a dress will be sufficient to indicate what may be expected to happen in a summer light. I believe it has often been remarked that at the seaside dresses "go" much more rapidly than at an inland place. The reason for this may be that there is more ozone and moisture at the seaside than there is inland. Ladies also inform me that abroad a dress may not fade in bright summer light when it inevitably would do so in our island. The air on the Continent is, as a rule, drier, and it may be that the want of moisture is the cause of the apparent stability of the colour. Wools and cotton-stuffs can be subjected to the same tests, but where the colours are on paper the tests are more rapidly carried out. The mordants often make the colouring matter more stable than it is on paper. Those dyes I have tried are on the dyed material.

DISCUSSION.

PROFESSOR J. M. THOMSON, F.R.S., in opening the discussion, said the matter was of very great interest, and it was very complicated. Looking at it from the chemical point of view, he did not think, so far as mineral colours were concerned, there was much difficulty; they were comparatively permanent. But with colouring matters of organic origin the reactions were very complicated. He thought it might be taken that the action in those cases was generally one of oxidation—he meant when pictures were exposed (as they usually were) to light, not when they were in a bad atmosphere. If they were in a bad atmosphere then other reactions were produced. He considered it was an oxidising action, that oxidising action taking place in the presence of moisture. If even the simple colours were taken—the action under strong light of oxygen upon those colours in the presence of moisture, or even in the presence of peroxide of hydrogen—it would be found that decay or bleaching would occur. The most important question was, how could that be prevented? People generally put up a water-colour picture in the most favourable conditions to produce bleaching. They put it up behind a glass plate, with a very imperfect backing as a rule, and when the sun shone upon that picture the glass got heated, the picture itself got heated, and the paper upon which the picture was put was acted on by the chemical agents equally with the colours. The paper itself had therefore to be considered. That paper, under most conditions of British weather, was moist, and the sun at once produced behind the glass an oven of moisture, and heaven only knew what actions were going

on between the partial decompositions proceeding in presence of moisture and the colours. One result of the author's and Dr. Russell's work had been to cause artists to look much more closely after their paper. A great deal of good scientific work had been done for artists, but he had been appalled by the apathy of the artists in taking advantage of that work. Many artists were quite ignorant of the materials they used. He desired to ask the author one question about Prussian blue. It was known that Prussian blue, when exposed to a bright light probably with the presence of moisture, faded, and a brown effect was obtained. He had two large water-colours in his collection which depicted originally beautiful bluey-green spring scenes. They were now certainly very pretty pictures; but they were autumn scenes – they were all brown. He had taken those pictures away from exposure by putting them into a dark drawer for years, but they not come back to their original colouring. He had read somewhere that a faded Prussian blue water-colour would come back if put in the dark. He had not actually experimented analytically upon those pictures, but he had taken Prussian blue and exposed it to light for a very long time. It partially faded As far as he could make out, the result of that was that it had gone into some peculiar iron compound. Therefore, he could not think the pictures would ever come back again to their original green colouring. Apparently, water-colours must be kept in a perfectly dry condition. He had no doubt that the whole of the action upon those pictures was due to the moist oxygenation which went on. It had occurred to him, while listening to the paper, that one way of preserving water-colours might be by putting them under a blue, a red, and a yellow glass, but they would not be much use to look at. He feared the only way for collectors to keep water-colours perfectly safe was to keep them perfectly dry, and in portfolios.

Mr. J. D. Crace said, in reference to Prussian blue, he might quote the experience of William Simpson, a very distinguished artist with a very inquiring mind. That gentleman had told him that he had put up on his shutter a piece of water-colour paper, across which he had painted strips with the different colours he ordinarily used, covered over half of it, and left it exposed to light for more than ten years. Some of the results were very curious. The yellow chrome, which he had always looked upon as one of the permanent colours, had distinctly faded; the Prussian blue, which he had always thought a very uncertain colour, had faded a little, but still kept its colour; and the part which was covered up was perfectly good as when it was first laid on; the blue of it had not changed, but only faded. That led him to think that perhaps Professor Thomson's pictures were painted with indigo. One or two of the items in the paper had rather astonished him. He had always looked on Hooker's green as a not very trustworthy composition. There was no question that damp enormously accelerated the fading of colour; and where pictures were under glass it was very necessary to protect them from dirt. He considered it very much helped the preservation of colour if the picture was in a sunk mount and not in contact with the glass, as in that case it would escape some of the consequences of condensation. He considered that a water-colour painted with a careful palette had a long life before it. Many of the pictures painted from fifty to eighty years ago were still so good as to distinguish themselves among modern paintings. It was largely a question of care. The water-colour not being locked up in oil it was so much the more easily influenced. On the other hand it retained purity and an absence of the discolouring of the vehicle, which in itself preserved an atmosphere and charm of colour which oil pictures could never possess.

Mr. Arthur Rackham said he was very puzzled to notice that the author had put chrome yellow among the permanent colours. There was a general impression amongst artists and artists' colourmen that cadmium was much more permanent than chrome. He wondered whether there had been a mistake in the paper, because chrome was now universally condemned. He also noticed among the permanent colours madder yellow. He did not quite know what that was, and would like to hear more about it. Light red was not among the colours at all, and he imagined that was quite a sound colour. He would also like to hear of a test for Chinese white Chinese white ought to be zinc white and permanent so far as light went, but there was no doubt that sometimes it was adulterated with lead, and darkened. He had also heard that the madders faded when mixed with blacks, the blacks being, he supposed, carbon colours, and the madder a vegetable colour, and tending to fade in the presence of charcoal. He would like to know whether that was a real danger or whether it was a chemist's splitting of straws, because one would like to use rose madder, and he did not know whether the modern substitutes, the aniline colours, were really as permanent as rose madder.

Mr. W. B. Ferguson, K.C., inquired if the author had experimented on the effect of the electric arc light on colours, and whether the influence of arc light was much the same as that of sunlight. Many people were not always in a position to command the use of an ozone-making apparatus, and many had utilised an arc light. Would it be possible to use that for testing, say, a wallpaper? To damp a certain piece of the wallpaper, keep a certain piece dry, and then to expose the damp piece for some time to the arc light? Perhaps the author would say whether such a method might be used as a practical means of testing the permanence of wallpapers and other pigments.

Mr. Charles Harrison said if anybody asked him what pigments were likely to be permanent

he would reply: "If you want pigments that are fairly permanent for ordinary living conditions, select those pigments which have been produced at a temperature somewhere about dull red heat." It struck him that there were three classes of pigments:—(1) Those which had a tendency to be acid in their composition; (2) those which had a tendency to be neutral, neither acid nor alkaline; and (3) those which had a tendency to be basic. It followed that if a man mixed an acid pigment with a basic pigment in conjunction with moisture and other atmospheric influences, decomposition must be expected, apart from light. With regard to water-colours, he would like the author to give an indication as to the usual kind of mediums or binders used by artists. He desired to call the author's attention to the question of heat. Vermilion was classed as a permanent pigment. He (the speaker) was not so sure he would call it that, because at a temperature of 50° C. it would gradually turn brown. He had come to the conclusion, after some study of the subject, that the only really suitable pigments were those which neither tended to be acid nor alkaline, but which were absolutely neutral in their chemical action: also they must be produced by a temperature about red heat. Zinc oxide was perhaps excluded, that would be quite safe, provided it did not come into contact with acid gases.

MR. JOSEPH W. LOVIBOND said amongst other things it had occurred to him that artists were rather hardly used in being blamed for not utilising the scientific information which was available. The standpoints of the artist and the scientific man were quite different, and their nomenclature even had little in common. There were other points to be considered: for instance, many colours had more than a single constituent, and one might be permanent and the other fugitive, so that the fading of the fugitive constituent produced a colour change. He considered these matters might be settled by research, and referred to methods by which the needed information might be obtained.

MR. THOMAS A. DAVIDSON, F.C.S., said he was not quite clear as to the construction of the apparatus which the author had described for testing the action of ozone on certain pigments. Were the tubes in which the colours had been exposed made of glass and transparent, and had the special intensity of light been considered?

MR. T. R. BURTON (the *Oil and Colour Trades Journal*) said that at the recent International Congress of Applied Chemistry, held at New York, Dr. Toch had made some observations which were very pertinent to the present lecture, and perhaps he (the speaker) might be allowed to quote them. Dr. Toch had said that water-colours were much more permanent, as a rule, than oil colours, because in the latter the medium introduced a greater possibility of chemical complications. He also, said that Prussian blue was among the most permanent of pigments; cadmium yellow was better than chrome; he classified silver white as permanent; the iron colours as liable to undergo chemical change due to oxidation, particularly in combination with oil; and vermilion he classified as not permanent.

THE CHAIRMAN (Sir Thomas H. Holdich, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc.), in closing the discussion, mentioned that he first learned to paint under John Callow, the brother of the better known William Callow, and his method of instruction was, he (the Chairman) always thought, an exceedingly good one. At the beginning he taught his pupils to paint with three colours only cobalt, lake, and yellow ochre. After a more or less imperfect mastery of those three colours the pupils were allowed to go on to three others—another red, blue, and yellow, that was to say burnt sienna, gamboge, and indigo The effect of John Callow's teaching no doubt was excellent, because the pupils did learn more or less how to use those six colours. The materials, however, which John Callow recommended left a great deal to be desired, for out of those six paints twice had been condemned as wanting in permanence. He (the Chairman) had found that lake was impossible to use if there was any chance of water-colours being exposed to strong light or to very great moisture; in fact, lake, certainly in combination with other colours, always turned black. Personally, he had no reason to complain, as far as his experience went, of water-colour sketches fading, and some of his had been exposed to light for thirty years. What he had found, rather than fading, was the tendency for colours not to intensify, but, as he believed, to oxidise and to turn black. That was the case not only with lake, but very much also with Chinese white. He thought, on the whole, the possessors of good water-colour pictures might fairly congratulate themselves that their pictures did retain the vividness of colour which was the original beauty of them. Speaking simply of life in the tropics—and he had been forty years in India—he thought, certainly that for those who aspired to keep a record of their lives in the tropics by means of artistic efforts, water-colour was decidedly the medium they should select rather than oils.

THE AUTHOR, in reply, said he had so many points to answer that he hoped he would be forgiven if he missed any. He was surprised to hear from Professor Thomson that the Prussian blue in his pictures had become brown. Was Professor Thomson quite sure it was Prussian blue? An artist did not often use pure Prussian blue, as it was much too violent a colour. If there was a moderate amount of fading of Prussian blue in a picture, if it was put away for a month in the dark the original vigour returned. If the Prussian blue went beyond the first fading, as might be the case with Professor

Thomson's pictures, then oxide of iron might form. He should feel inclined to say that Professor Thomson's pictures were painted with indigo. One speaker had said he thought Hooker's green was a dangerous colour. He (the author) quite agreed, because it was composed of Prussian blue and gamboge. Nobody in their senses would use gamboge of necessity, because it was proved to fade. But in the paper he had referred to a new sort of Hooker's green, in which the gamboge was replaced by aureolin. That exactly matched the Hooker's green, and was permanent. Another gentleman had expressed surprise at seeing chrome yellow put in the list of permanent pigments. It was perfectly true that Dr. Russell and himself tried chrome yellow. In the artists' list chrome yellow was shown as one of the pigments used frequently, and therefore he and his colleague were bound to see whether it faded in the light. Yellow chrome by itself did not fade in the light. He did not think nowadays anybody would put chrome yellow in his colour-box, because certain actions took place with chrome yellow when other colours were mixed with it. Personally he should never think of using chrome yellow. Then a comment had been made on the fact that he had not mentioned light red. One could put light red and Venetian red one on the other, and it did not make the slightest difference; they were exactly the same. He had tried both, and neither had faded. With regard to Chinese white, he was not sure that pure water-colour artists ever used Chinese white, and therefore he had not paid any attention to it. It had been found, however, in the experiments that the Chinese white as supplied did not blacken, but he would rather not pledge himself about Chinese white, as water-colour artists seldom used it. With regard to the question whether madders faded when mixed with blacks, it was rather fatal to mix those delicate colours with black. If, for instance, madder purple was mixed with black, a change must be expected. There was something peculiar about the mixture of black with such colours that required a little more investigation. A very sensible question had been asked about arc light and ozone. When an arc light was used a lot of ozone came off. The action would take place with the arc light, but it would not occur as quickly as with the ozone tube, where the ozone was all conducted to the pigment. Those who had an arc light could very easily experiment for themselves. It might be taken that an arc light had very much the same action as sunlight. He had been delighted to see Mr. Lovibond present. That gentleman's tintometer for measuring delicate shades was well known, and science generally was grateful for it. He thought the burden of Mr. Harrison's remarks was that vermilion was classed as a permanent colour, and that at a temperature of 50° C. (122° F.) it would turn brown. That was a pretty high temperature, and probably Mr. Harrison was right, but he (the author) thought the temperature at which vermilion had to live was rarely above 100° F. He had not found himself that vermilion had turned black. In the original report it was shown that vermilion had turned black, to a certain extent; but when the blackness was taken off by scraping, the vermilion was found intact underneath. He had been very interested to hear how the Chairman had been taught in three colours. That was an ideal method, but there were some colours which could never be obtained with three colours; the tint would be obtained, but not the proper depth.

On the motion of the Chairman, a hearty vote of thanks was accorded to the author for his interesting paper.

THE OCCURRENCE OF VOLCANIC ASH ON THE GREAT PLAINS OF NORTH AMERICA.

By Chas. N. Gould, Ph.D.

Volcanic ash (pumicite) occurs in large quantities on many parts of the great plains of North America. It has been found most abundantly in western Nebraska, Kansas, Oklahoma, and Texas, and in eastern Colorado and New Mexico.

This material, which is ordinarily white or cream-coloured, usually occurs as rather loosely-consolidated beds, varying in thickness from a few inches up to 10 ft., and occupying an area sometimes of several acres. These beds are lens-shaped, and are usually found interstratified between shales, clays, and sandstones of the Tertiary age, which latter deposits occupy the greater portion of the parts of the States mentioned.

The origin of this material is not absolutely known, but it is believed to have come from volcanoes, presumably of the Tertiary age, the remnants of which are in evidence at points west of the present deposits in certain parts of New Mexico and Colorado. Theoretically it is assumed that at the time of eruption this volcanic ash was carried by strong western winds, and spread out over the surface of the country. Afterwards this surface was submerged, and the deposits were buried under the superimposed sediments. Erosion is now uncovering these various beds.

Within the past few years certain deposits have come to light in eastern Oklahoma, at a distance of at least 400 miles from the nearest known Tertiary volcanoes. The age of these deposits cannot be accurately determined. They are known to be post-Pennsylvanian in age — that is to say, they now occupy a position on rocks of Middle-Carboniferous age. The exact time of their deposition may have been anywhere later than late Paleozoic.

An analysis of this volcanic ash indicates that the material is largely silica, varying from 95 to 99 per cent. SiO_2. A microscopic examination shows that the particles are glassy, transparent, irregular in shape, and consist of minute fragments and spicules.

This material has been mined locally, and is

used chiefly in the preparation of various scouring compounds. It is mixed with animal and vegetable fats and oils, and sold under a variety of trade names. Immense deposits of the material are available, but heretofore only a very small amount of it has been utilised.

SOCIAL AND ECONOMIC PROGRESS OF THE NEGRO FARMER IN THE UNITED STATES.

On January 1st, 1863, Abraham Lincoln proclaimed the abolition of slavery in the United States; other laws which followed between that date and 1865 completed the liberation of the slaves by giving them full rights of citizenship. Almost half a century, therefore, has passed since the negroes were admitted to form part of the civil and economic life of the great American nation—half a century in which they have made enormous progress.

The *Monthly Bulletin of Economic and Social Intelligence* devotes an article to the study of the progress of the negroes in agriculture. Since the majority of the negroes (2,143,154) are employed in agriculture, the article in question covers the most interesting part of the story of the progress of the race.

Before 1861 the negro slaves in the United States were confined to the South, and furnished the whole of the labour required on the plantations for the cultivation of cotton, sugar, rice, and indigo. They were the type of labourer best adapted to work under the system which prevailed at that time—hard-working, obedient, inured to fatigue. It was but natural, therefore, that the Southern States should oppose the abolition of slavery; and their opposition yielded only after their unsuccessful appeal to arms in the War of Secession. Even after the war discontent against the laws freeing the slaves was manifested in different forms, and a period of unrest and internal disorder followed the year 1865.

From 1865 to 1872 there was a very large emigration of negro workers from the country into the towns. The movement did not cease when normal conditions were re-established in the South, though it is now in the nature of a natural current towards the towns, about equal in degree to the parallel movement on the part of the white population, and due to analogous causes. At the present time, out of a total of 9,800,000 negroes, 8,700,000 are in the Southern States.

But while the number of negro agricultural labourers has been diminishing relatively, by comparison both with the numbers of white labourers and with the number of negroes employed in other occupations, the opposite is true of the other classes of negroes engaged in agriculture. Relatively, the share-croppers, tenants, and proprietors are increasing.

This is a reassuring circumstance, as it shows that the tendency is for the negro to improve his position. He rises slowly and gradually from the lowest form of share tenancy, which is really only a method of hiring labour—the labourer being kept on the land by retaining, until the crop is harvested, that part of his salary which is paid in kind—up to the more developed forms of share tenancy, and finally, to tenancy with complete responsibility.

Whether we are considering the number of farms (21 per cent.) or the area cultivated (7 per cent.), the increase in the negro farmers working under the latter tenancies has notably increased in the ten years from 1900 to 1910.

But still more commendable has been the acquisition by negro cultivators of the ownership of land.

Whereas in 1861 the few free negroes living in the United States owned but an insignificant amount of the total farm land, the census of 1900 gives the value of the property owned by negro cultivators as about 230,000,000 dollars, and the following census in 1910 places the value of the agricultural property (land and buildings) belonging to coloured farmers in the Southern States alone at 272,900,000 dollars, as against 106,600,000 dollars in 1900.

This result must be considered remarkable when it is remembered that fifty years ago the negroes possessed nothing—neither inherited land nor the money to acquire land for themselves. To reach the point at which they are to-day, the negro farmers have had to exhibit powers of working and of saving which might in some cases with justice be called heroic.

The various agricultural associations which exist, uniting as they do the scattered efforts of the worthiest representatives of the race, have contributed much to the progress of the negro in agriculture. Equally admirable has been the work of the Federal Government and of the separate States, of Universities, of religious institutions and of individual patriots and philanthropists.

With the help of all these forces the negro farmer is making rapid progress, not only economically, but intellectually and socially as well. He is becoming a better farmer and a more valuable citizen.

THE COMMERCE AND INDUSTRIES OF MADEIRA.

Since the inauguration of winter cruises to the Mediterranean the island of Madeira has developed rapidly, and its industries are flourishing. The island lies off the coast of Morocco, 550 miles south-west of Lisbon, and 640 miles from Gibraltar, and is about 40 miles long from east to west and 15 miles wide from north to south. It is of volcanic origin, and its mountains attain an altitude of 6,000 ft. About half the total area of 175,000 acres is under cultivation, and of a population of 170,000 two-thirds are engaged in agriculture. With a mean annual temperature of 66° F. Madeira is a well-known winter resort, with a tourist population of 3,000 during the season. Funchal, the capital, is a port of call for vessels between Europe and

North and South America, and it is estimated that the total annual transient population is about 150,000 persons, of whom 34,000 are en route to or from the United States.

The embroidery industry is the most important on the island, employing 40,000 to 50,000 persons, and having an annual output valued at £165,000. Embroideries are exported to the United Kingdom, France, Germany, and the United States, and, according to the American Consul-General at Lisbon, the latter country receives very considerable quantities of Madeira embroideries.

The annual production of Madeira wine is 12,000 pipes. Sugar-cane has supplanted the vine in many parts of the island. In 1912, 48,000 tons were used, yielding 4,200 tons of sugar, 4,000,000 quarts of treacle, and 42,000,000 quarts of alcohol. Generally the industry works with cane juice of a grade of 8° or more Baumé, and the yield of sugar is about 10 per cent. Five hundred men are employed in the sugar factories. In 1911 the Government placed a tax on alcohol, to be levied until 1918, which yields an annual revenue of £22,000.

The wicker furniture industry employs 600 persons, and the annual exports amount in value to £14,000. Inlaid woodwork gives an annual return of £2,400. The demand for furniture in these styles comes chiefly from visitors to the island.

The canned and salted fish business has seen considerable development in recent years, and now employs about 3,200 persons. Shipments are made to the United States and Northern Europe. About 4,000 skins of kids are exported to Oporto each year for use in glove manufacture.

Madeira is rich in fruits, and large quantities of bananas are exported, principally to Portugal and Continental countries generally. A special service has been organised by the Government to foster and protect fruit trees. Owing to the regular fast steamship service between Funchal and the ports of England and the Continent, it is proposed to undertake the shipment of flowers, which grow in great profusion in all parts of the island, and are in blossom the year round. The manufacture of perfumes is also under consideration.

One of the great drawbacks to the development of Madeira has been the lack of transportation facilities, but the local government has planned many improvements. A railway runs from Funchal 3,000 ft. up the mountain to a large hotel. Between Funchal on the south and Porto Moniz on the north a road, 20 ft. wide, is under construction, much of it cut out of the solid rock. An appropriation of £150,000 has been made for opening public highways and improving the drainage system. Ox-carts for passengers and goods are giving way to motor transport. There are sixty-five motor-cars in regular service, although the only available thoroughfares are the streets of Funchal, and a road running to suburbs on the coast about seven miles in each direction. Since the streets are paved with pebbles and cobblestones, motor-cars need to be strongly constructed.

ARTS AND CRAFTS.

Metalwork and Jewellery.—Messrs. Ramsden and Carr's annual show of metal and silversmiths' work has come to be an event to which many people look forward with pleasurable anticipation. It was, therefore, satisfactory to find that the absence of one of the partners with his regiment did not prevent the exhibition from being held. The effects of the war had not, of course, as yet had time to tell upon the work shown; orders for large objects, now sufficiently advanced to be exhibited, must have been placed well before August, and it had been possible to arrange a very representative collection of work. This year the large-scale metalwork occupied a conspicuous place. Three altar crosses were on view, two in brass and one in gunmetal, as well as a crozier and several sets of altar candlesticks - all of them very well worth notice. The more important silver work included a covered standing salt for the Worshipful Company of Merchant Taylors, remarkable for its wealth of symbolism, and a pair of candlesticks in wrought and repoussé silver, with briar rose decorations, which were thoroughly fresh in design and conception. The drawing for the chalice and paten for the Chapel of Whitelands College also promises well. A set of jewels comprising the St. Christopher and the Tristan and Isolde rings the one in gold and platinum, the other in chiselled gold alone -the St. George pendant and the bracelet in hand-wrought platinum and blue moonstones were, however, in some respects the most remarkable exhibits. The small objects, it is true, allow less scope than the larger ones for the display of those virile qualities for which Messrs. Ramsden and Carr are best known, but they offer ample opportunity for refined and fanciful design and workmanship We have at present many artist-jewellers doing good work along the lines of the tasteful combination of stones and simple wirework, but their attempts at the introduction of the figure or at chiselled work of any kind, though occasionally suggestive, are almost invariably rather heavy. They all seem to assume an inordinately large and imposing person to wear the trinkets and to carry them off. Messrs. Ramsden and Carr's figure work, on the other hand, is eminently fit for its purpose, besides being artistically conceived, and it may, therefore, be looked upon as more or less of a triumph.

Fans.—The Loan Collection on view at Messrs. Colnaghi and Obach's, in aid of the Queen's Work for Women Fund and the Australian Contingent Association, is at least as interesting from the point of view of the artistic craftsman and the lover of decorative painting as from that of the painter. It includes not only a very good and representative assemblage of fans and drawings on silk by Charles Conder, which show to the best advantage that artist's delicate colour and tender fancy, but also an extremely interesting collection of eighteenth and nineteenth century

fans lent by Mrs. Frank Gibson. The fans shown are English, French and Spanish (there is one Italian fan mount), and it must be admitted that the French work has, as a rule, a lightness and refinement which is lacking in English specimens. That defect is, however, rather characteristic of the smaller English work of the period. When seen by itself it often looks very satisfactory, but in juxtaposition to French painting or furniture it generally presents a rather clumsy appearance.

The thought which the collection suggests is that English craftworkers have been neglecting what really is an opportunity. Several artists of repute have painted fans, but the artist craftsman has, with very few exceptions, left them severely alone. And yet, as the beautiful French and Spanish work on view at Messrs. Colnaghi's indicates, the fan offers him a splendid opportunity. The wood-carver has a chance to try his hand at simply carved mounts, but above all the needlewoman is afforded an excellent opening for the display of her taste and her capacity for simple design. Elaborate embroidery is, it is true, rather out of place on a fan which has to be repeatedly opened and shut. Beautiful lace, enchanting as it may look, is hardly effective from a practical point of view. But the old workers have shown us how altogether satisfactory a design of sparingly used spangles can be, and simple needlework arranged so as to take advantage of the rounded top of the open fan and to balance it by insistence on the radiating lines of the mount would have a very charming effect. Cheap Japanese fans have of course many attractions; it would be quite impossible to compete with them, and they answer many purposes quite admirably. Hand-painted fans by really first-rate artists are beautiful, but quite beyond the purse of the ordinary buyer There ought to be an opening for something between the two extremes of price, and any needlewoman with some knowledge of design who visits the present exhibition should come away with some idea of how to plan a fan which would be attractive and yet fairly simple in character.

Christmas and the Artistic Crafts.—Christmas is generally the harvest time of the small artist craftsman, and it is satisfactory to find that although some of the opportunities which are usually provided at this time of year for the disposal of his goods are lacking, other means of showing his work have been found. Various sales have been held, and, further, British hand-woven goods were shown at one of the London shops. They made a very good display in the windows. though the people who had charge of the selling might, with advantage, have been taught a little more about the wares, and have been brought to a better understanding of the reason why hand-woven goods are so much more expensive than those which they are normally accustomed to handle. Some of the exhibitors, for their part, would probably have sold better had they taken the pains to try to put themselves into the position of people buying Christmas presents. The demand in London at this season of the year is always mainly for small and comparatively inexpensive objects suitable for presents. It is only natural that in a war year there should be a contraction rather than an expansion of the market for large and comparatively costly work In any case, the experience of those who are trying to sell craftwork this season seems to be that while there is, all things considered, a very fair demand for little inexpensive objects, no one wants to buy large and expensive things.

It is always difficult to hit the happy mean between producing fine things which will not sell and descending to the making of knick-knacks, fit, perhaps, for a bazaar, but not worthy to be considered seriously from the point of view of either art or craftsmanship. It is to be hoped that our craft workers will not despair of solving the problem.

Artistic Toys.—A certain number of more or less unemployed artists and craftwomen seem to be drifting into the toymaking industry, which is now being so vigorously prosecuted. The whole trade is, of course, at a highly experimental stage, but if it can be made sufficiently successful to employ permanently, at proper wages, a fair number of people with some artistic training and taste, a very excellent work will have been accomplished. It is really remarkable, when one comes to think of it, that while in recent years so much has been done to improve the artistic quality of children's picture-books, we have been content to allow so many of their best beloved toys to be so hopelessly ugly. The trouble is probably due to the prevailing passion for cheapness. German toys were cheap, and while they were available it was no use trying to introduce a more expensive type of thing, however much better it might be. Of course, some of the all-British toys being made are in no sense artistic; and there are toys much beloved of children, such as penny whistles and mouth-organs, to say nothing of guns and cannons, which do not lend themselves to artistic treatment. Again, though it may be heresy to say so, the average small child has not very strong predilections in the direction of art, and generally prefers a frankly hideous gollywog to the most highly impressionistic, or even futurist, spook. On the other hand, one cannot but feel that if only Noah's Ark animals and the like could be made in some quantity, and at a reasonable price, on the lines of the really beautiful beasts lately shown in Bond Street and elsewhere, the children who played with them would love them, and at the same time would get some idea of what the animals really looked like, which is far from being conveyed by the four-legged objects enclosed in the ordinary Noah's Ark. With regard to the people, it might be rather sad to have to give up discussing which was Mr. and which Mrs. Noah; but, after all, that

question is really more often raised in the first instance by the grown-ups than by the children themselves. We are beginning to see in the various shops this year a certain number of toys, not all of them very expensive, which show that those who have had a hand in their making have some artistic sense, and are at the same time keeping before them the child's point of view. It is to be hoped that the efforts directed towards building up a British toy industry will continue to include a consideration of the artistic side of the matter, and that when the trade is fully grown it will not offer us copies of German productions, but will put upon the market better animals, farms, carts, shops, etc., than those which have been imported. At present, some of the superior toys are being hand finished by trained carvers or painters, a proceeding which opens up almost infinite possibilities for the future.

CORRESPONDENCE.

HIDES AND TANNIN EXTRACT OF QUEBRACHO.

It might be useful at the present juncture to point out the large quantity of hides and tannin extract of quebracho which is usually exported from this country to Germany.

Owing to the war many of the tannin factories are closed, and the price of hides in the camps has fallen to 0.25 cents paper per kilo (twopence per pound). Great quantities of leather must be used in the war, and English tanners might well take the opportunity of extending their operations.

The tannin of quebracho is contained in the wood, and one ton of timber gives one-third ton of tannin extract. An acacia called cebil contains a superior tannin in its bark, but there is no commercial development of this product on a large scale.

Quebracho tannin extract costs about £15 per ton to produce at the works. The supply is unlimited.

Requests for further information may be addressed to me at the Royal Colonial Institute, Northumberland Avenue, London, where I shall call next month.

KINSLEY D. DOYLE.

650 Calle 24 de Setiembre,
Tucuman, Argentina,
November 17th, 1914.

THE TRAINING OF INDUSTRIAL CHEMISTS.

Mr. Dibdin's letter on this subject raises a question that was not dealt with in the papers of Sir William Tilden and Dr. Ormandy, and which has an important bearing upon the future of chemical industries in Britain.

Manufacturers are in some cases, no doubt, ignorant of the scientific principles which govern their processes, but on the other hand there are many who fully appreciate the value of constant research, but experience a difficulty in finding men capable of carrying it out. It is not always possible to distinguish between "pure" and "applied" chemistry; but where our colleges usually fail is in not impressing upon the students the application to industrial processes of the principles taught. As a result, as Mr. Dibdin points out, the students of such colleges require training afresh before they are capable of filling situations in industrial life. Sir Walter Noel Hartley, who was a pioneer in the teaching of industrial chemistry, used to preface his lectures on this subject with a remark that deserves the widest recognition: "There is almost an infinite difference between a process carried out in a beaker in the laboratory and on the large scale for commercial purposes." The truth of this dictum does not seem to be realised by most of our teachers, and in consequence the type of student turned out is unsuitable for industrial requirements. As an example, I have frequently met students thoroughly conversant with all the laboratory methods of producing low temperatures, but who did not understand the working of a commercial refrigerating machine, and could not recognise one when they saw it. The text-books used are in most cases solely devoted to laboratory methods, although occasionally a brief mention may be made of the outline principles of a large-scale operation, as a sort of addendum to the laboratory process. It is largely owing to this omission to teach industrial chemistry that the manufacturers in this country have little confidence in the colleges or in the class of men who have been trained therein.

Turning to the question of research, the same ignoring of industrial problems may be observed. All research is of the highest value, as extending the bounds of our knowledge, and should therefore be fostered. The vast majority of the chemical researches carried out at our colleges, however, have no commercial significance, and do not attract either the manufacturer or the financier. Often, moreover, a successful laboratory investigator may fail to succeed in solving industrial problems, where machinery takes the place of the spatula, and the large furnace that of the Bunsen burner. Success in industrial research involves far more than a knowledge of chemical principles; it entails an intimate acquaintance with machinery of various kinds, the economic working of furnaces, temperature control, and many other matters of which the student who has worked only for a degree has no knowledge. Research of this character, when not conducted by a member of the works staff, is referred to the consulting chemist, who, not usually being free to publish the results of his investigations, gets little or no credit either from the public or in scientific circles. The only sources from which the manufacturer can obtain chemists who are immediately of use to him for research purposes are the laboratories of the

consulting chemists, and from the very few colleges in which a training in industrial chemistry is given preference to preparation for a degree. My own experience confirms that of Mr. Dibdin, that there is no difficulty in placing suitably-trained students in satisfactory positions; indeed, the demand is often greater than the supply.

If we are to have that co-ordination between the teacher and the manufacturer that exists in Germany—to the great advantage of both—the teaching of chemistry must not, as at present, be mainly confined to the cloister. We must either introduce courses of instruction in industrial chemistry into our existing colleges and universities, conducted by men of experience, or create new institutions for the purpose. We must look upon industrial knowledge as an educational asset equal in importance to book knowledge, which at present we do not. So long, however, as educational authorities continue to regard the possession of a degree as the only criterion of ability, and form their staffs almost exclusively of men who have had no industrial experience, they will never give that effective assistance to the manufacturer which will enable us to hold our own in the sphere of chemical industry.

CHAS. R. DARLING.

GENERAL NOTES.

PANAMA CANAL TRAFFIC.—From an article in the *Canal Record*, which publishes an interesting analysis of the traffic of the Panama Canal, it appears that during the first three months of its commercial operation, from August 15th to November 15th, the cargo transported through the Canal has amounted to 1,079,521 tons. During the fiscal year ending June 30th, 1914, the Panama railroad carried 643,178 tons of through freight between the two seaboards, and in the preceding year 594,040 tons. From this it is seen that between six and seven times as much cargo is passing over the Isthmus now as passed over this route when goods were transhipped by rail. In other words, the traffic through the Canal in the first quarter-year of its operation has been equal to about 88 per cent. of the through traffic over the Isthmus during the preceding two years.

THE ANGORA GOAT.—During the last few years great attention has been directed to the breeding of Angora goats in the United States of America. The value of the 1909 clip of mohair was $901,597, which is nearly four times the value of the clip of 1899. The number of fleeces increased during this period from 454,932 to 1,682,912. The weight of fleece for American Angoras varies from 2 to 12 lbs. The fleece of a one-year-old goat weighs about 2½ lbs. The total weight of fleeces produced in the United States in 1913 amounted to nearly 5,000,000 lbs. Besides this considerable home production, the United States import about 2,000,000 lbs. of mohair, which is on the average superior in quality to the American produce. The best conditions for goat-breeding exist in the north-western States, where there is abundance of brush, and where the goats contribute greatly to the control of forest fires by clearing brush lands.

POTASH SALT SUPPLIES.—Attention is drawn in the annual report of the Royal Agricultural Society of England to the cutting off of the supplies of kainit and other potash salts caused by the outbreak of war. These salts were obtainable only from the Stassfurt and other mines of Northern Prussia. By this great difficulties will be imposed alike on the farmer who needs potash on his land and on the manufacturers of artificial compound manures. At present there is no regular supply to be obtained elsewhere, though it may be found possible to use the insoluble felspars and other minerals as a source of potash. From India and elsewhere supplies, to a limited extent, of nitrate of potash (nitre) may also be available at enhanced prices. Possibly, too, the dearth of potash salts may lead to the revival of the practice of kelp (seaweed) burning; but these and other remedies suggested can only be looked upon as very partial means of supplying the need. Meantime it is well to remember that Peruvian and other guanos frequently contain notable amounts of potash, as does also farmyard manure.

THE NEW ZEALAND WOOL AND FROZEN MEAT INDUSTRIES.—Wool is the most important article of export from New Zealand, and its production is growing steadily. Great progress has been made in the last decade in improving the quality of the sheep, and breeding for greater quantity as well as better quality of fleece is now being made the subject of careful study. It is estimated that the scientific farmer gets an average of fully 30 per cent. more wool from each sheep than was obtained ten years ago with a better quality of product. The commercial prosperity of New Zealand commenced with the advent of the freezing chamber in 1882, enabling the sheep farmer to utilise the carcass of the animal as well as the fleece. Frozen meat ranks second among the exports of New Zealand produce. The growth of the industry is illustrated by the fact that the exports in 1882 amounted to 1,707,328 lbs., while in 1910 they were 291,200,000 lbs. Given a demand at remunerative prices, this industry is capable of indefinite expansion, for there are yet large areas of suitable land that only need to be furnished with transportation facilities to be rendered available for settlement.

AN EARLY SUBMARINE BOAT.—In view of the important part now played in naval warfare by submarine vessels, it is interesting to note that fifty-five years ago (January 14th, 1859) the *Journal* contained an account of an American invention of which it was claimed that "it would make such a change in the mode of carrying on a naval war as would put steamers out of the question, and render of no avail the tremendous forts of

Kronstadt and Cherbourg ... It is nothing less than a submarine boat, made only for working under water, in form much resembling the shape of a porpoise, but capable of being made large enough to contain eight, ten, or even fifteen men, if necessary, with a proportionate quantity of explosives." The patentee stated that he, with others, had submerged the boat in Lake Michigan, and remained under water for four hours, without any air tubes or other communications, and propelled the boat in and near the bottom of the lake for several miles at the rate of about three miles an hour. He claimed that he could convey powder torpedoes of 100 lbs. weight in his boat, and when under an enemy ship pass them out of the side of his boat through his patent hatch, fasten them to the ship's bottom, and fire them. One of the most remarkable points about the description is that he appears to have used a periscope. "He can enter an enemy's harbour under water and make surveys, only showing above the surface a sight tube no more than one half-inch in diameter, and retire still under water, and proceed out to sea and make his report to the commander of a fleet or ship." The account in the *Journal* says nothing of the means proposed for supplying the crew with air, nor is any description given of the means of propulsion

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock:—

January 20.—J. A. Hunter, "The Textile Industries of Great Britain and of Germany." Lord Rotherham, President of the Textile Institute, will preside.

January 27.—Hon. John Collier, R.O.I., "Portrait Painting." Lord Sanderson, G.C.B., K.C.M.G., will preside.

February 3.—Octavius Charles Beale, Chairman of the Australian Manufacturers' Association, "Imperial Industrial Development after the War."

February 10.—F. Vincent Brooks, "British Lithography in 1915."

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

January 21.—Henry John Elwes, F.R.S., "Nepal."

February 11.—Captain Sir George Duff Dunbar, Bart., I.A., "Tribes of the Brahmaputra Valley."

March 18.—Lieut.-Colonel A. C. Yate, I.A. (retired), "The Indian Army."

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

January 26.—Major E. H. M. Leggett, R.E., D.S.O., Managing Director of the British East Africa Corporation, "The Economic Development of British East Africa and Uganda."

February 2.—Edward R. Davson, "Colonial Sugar Development."

Dates to be hereafter announced:—

Thomas Worthington, "The Work of the Commercial Intelligence Branch of the Board of Trade."

T. Thorne Baker, "The Industrial Uses of Radium."

Frank Baines, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

E. W. Hulme, "Patent Law."

H. M. Thornton, "The Industrial Uses of Coal Gas."

D. Y. Cameron, A.R.A., R.E., "Etching."

Roger Fry, "Post Impressionism in Design."

C. H. Sherrill, "Ancient Stained Glass."

William Poel, "Shakespeare's Profession."

Arthur Wilcock, "Designing for Textiles."

Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

M. M. S. Gubbay, I.C.S., "Indian Trade and the War."

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

April 15, May 13.

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

March, 2, 30, May 4.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

Dr. F. Mollwo Perkin, F.I.C., F.C.S., "Oils, their Production and Manufacture." Three Lectures.

January 18, 25, February 1.

M. H. Baillie Scott, "House Building—Past and Present." Three Lectures.

March 15, 22, 29.

David Sommerville, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

Fothergill Lectures.

Monday evenings, at 8 o'clock:—

Professor Vivian B. Lewes, F.I.C., F.C.S., "Motor Fuel." Three Lectures.

February 15, 22, March 1.

Juvenile Lectures.

Wednesday afternoons, at 5 o'clock:—

H. Plunket Greene, "How to Sing a Song. Two lectures, with vocal illustrations.

January 6, 13.

Journal of the Royal Society of Arts.

No. 3,240. VOL. LXIII.

FRIDAY, DECEMBER 25, 1914.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

JUVENILE LECTURES.

The usual short course of lectures adapted to a juvenile audience will be delivered on Wednesday afternoons, January 6th and 13th, 1915, at 5 p.m., by Mr. H. Plunket Greene, on "How to Sing a Song."

Special tickets are required for these lectures. They can be obtained on application to the Secretary.

Most of these have now been issued, but some still remain, which will be issued to Fellows who apply for them at once.

LIST OF FELLOWS.

The new edition of the List of Fellows of the Society is now ready, and can be obtained by Fellows on application to the Secretary.

COVERS FOR JOURNALS.

For the convenience of Fellows wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1*s.* 6*d.* each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE HISTORY AND PRACTICE OF THE ART OF PRINTING.

By R. A. Peddie,

Librarian, St. Bride Foundation Typographical Library.

Lecture I.—Delivered November 23rd, 1914.

Printing with moveable types was invented either in Holland or Germany about the year 1440. The name of the inventor and the place of the invention are two of the most hotly contested questions in history. Gutenberg at Mainz, Coster at Haarlem, Waldfoghel at Avignon, Castaldi at Feltre—all these are mentioned as claimants. The value of their respective pretensions has been summed up by a well-known authority in the words: "Holland has books but no documents, France has documents but no books, Italy has neither books nor documents, while Germany has both books and documents." There exist books certainly printed in Holland which are held by some to be earlier than 1454, which is the first printed date of the Mainz press. They are attributed to the press of Laurens Janszoon Coster of Haarlem, but this is not supported by any direct evidence. As to the Avignon claim, this rests upon some documents in the legal archives of the town. Waldfoghel, who was a goldsmith, was in the possession of a method of artificial writing which, by the description given, must have been printing. No work done by him or by his method has been identified.

The claim of Castaldi, of Feltre, appears to rest upon very shallow foundations, and, in fact, it is difficult to see anything but tradition in the story. When we turn to Mainz we are on more solid ground. From the first Mainz press —it is difficult to associate John Gutenberg definitely with it—a broadside Indulgence was issued with the printed date of 1454. Through the haze of tradition, theory and speculation, this Indulgence emerges as a definite fact, and from this date begins the real history of printing with moveable type. From what we know of the operations of typefounding to-day we can see that it must have taken many years of experiment and of failure to enable the printer of the 1454 Indulgence to arrive at the final solution of the problem. From the press of Mainz also was produced the first Latin Bible, originally known as the Mazarine Bible, afterwards described as the Gutenberg Bible, and now called by all good doubting bibliographers the forty-two line Bible, which title commits no one. This Bible was printed before August, 1456, as a copy in the Bibliothèque Nationale

has a rubricator's date of that year. In 1457 appeared the Mainz Psalter, the first book to bear the name of its printer, the name of the place where it was printed, and the date of its production. To add to this, it contained the first attempts at colour printing and the first ornamental initials. The printers were Johann Fust and Peter Schöffer, and this Psalter, together with the other books from their press, showed a great advance from the work of the two first presses in Mainz.

The work of these pioneer printers must have been much hampered by the poverty of their implements. There is little doubt that the earliest press used was a simple linen-press, and a small one at that. The ink was an invention, if not in itself, in its application. With these poor instruments, and with type that must without doubt have been irregular and badly cast, the pioneers of the printing art produced the magnificent works which remained, perhaps unequalled, and certainly not surpassed, for many years.

From the Mainz press, with its colour-printed initials, we pass to Strassburg. Here as early as 1460, and perhaps two years earlier, Johann Mentelin was printing and using a type which began to show the first modification towards the round or Roman type. Everything up to this time had been printed in the type which is known generically as the Gothic or Black Letter type. About the year 1464 a press was established at Strassburg which used a definite Roman type. The printer, formerly known as the "R" printer, owing to the curious form of the capital R in the fount of type he used, and whose books were originally confused with those of Mentelin, is now identified as Adolph Rusch, the son-in-law of Mentelin. The first Roman type, therefore, is found in Germany, although we have to look to Italy for its later development. The next press to be mentioned as showing development in the art is that of Albrecht Pfister, of Bamberg. Pfister is a mysterious person, being connected in some way with the earliest presses in Mainz, and by some is looked upon as the printer of the thirty-six line Bible, which by most bibliographers is attributed to the printer of the 1454 Indulgence. The interesting point about Pfister is that seven out of the nine books from his press are illustrated with woodcuts, and form the first attempt at book illustration. None of them can be placed later than 1462. No more illustrated books occur until about 1470.

The next important event is the establishment of printing in Italy. Sweynheym and Pannartz, two German craftsmen, started work in Subiaco near Rome in 1465. They used a type which was not Gothic and not quite Roman, and is generally described as Semi-Roman. It was not based on the same style of writing as the first German Roman, as will be seen when the two are compared. Two years later, in 1467, when these printers moved to Rome, their type became still more Roman in character; but it was not until 1471 that the new character, which was really the older form of letter (this is recognised by the Germans, who to this day call it Antiqua), reached its highest point, in the type used by Nicolas Jensen, a Frenchman, who printed at Venice. This type, perfect in outline and balance, has held its artistic supremacy to the present day. The Roman type failed, however, in its competition with the Gothic, which held the field all over Europe during the fifteenth century.

Up to 1465 the Gothic and the Roman were the only type-faces in use. In that year Greek type was used by Sweynheym and Pannartz at Subiaco, and by Fust and Schöffer at Mainz. Previously a space had been left where a Greek quotation was required, and it had been written in by hand, or in some cases stamped in. The first book to contain a full Greek text was printed by Ferrandus at Brescia about 1473. It was the "Batrachomuomachia" of Homer, and the book also contained a Latin translation of the work. The development of Greek printing was rapid in Italy, but slow in the other countries of Europe.

Printing began in Switzerland about 1468 at Basel, and in 1470 in France at Paris. It is strange that Paris was so late introducing the printing press, as there is no doubt that specimens of the art had been seen there in 1466, and it is believed that Jensen was sent by Charles VII. to learn the new art as early as 1458. On his return to Paris, finding his patron, the king, dead, and encountering considerable opposition from the scribes and copyists, he went to Italy and ultimately established his press at Venice. The first Paris press was established under the patronage and by the exertions of professors of the University of Paris, and the press itself was set up within the precincts. The printers, of course, were Germans, and their work was largely reprints of classical texts. The Roman type used by these printers was of a very high artistic character, Mr. Gordon Duff, in fact, going so far as to say that it far surpasses Jensen's in beauty.

By 1473 printing was definitely established in the Low Countries, both Utrecht and Alost producing dated books in that year. In 1475 occurs the first use of Hebrew type. Piove di Sacco and Reggio di Calabria in Italy, and Esslingen in Germany, were the towns where it was first used. Many Hebrew presses were set up in Italy during the last quarter of the fifteenth century, and several in Spain and Portugal.

In 1475 the art reached Austria, and in the same year Spain. The first book printed in England was issued from the press of William Caxton in 1477. The false date 1468 appears in an Oxford edition of Rufinus on Jerome's exposition of the symbols of the Apostles. This date has given rise to a considerable amount of controversy. Richard Atkyns in 1664 alleged that this book was printed by Frederick Corsellis, a workman from the press of Haarlem, who was bribed to come to England by order of Henry VI. This story was based on a manuscript alleged to be in the Library at Lambeth Palace. No one, however, has seen that manuscript from Atkyns' time to the present day, and as it is certain that the book dated 1468 was printed in 1478 by the first Oxford printer, I think it may be taken that the existence of the said manuscript is very doubtful. However, the king (Charles II.) believed Atkyns' story and gave him the patent for law-book printing. The press in England was not responsible for any great advance in the art—in fact, English printing of the fifteenth century was of a comparatively low order.

About 1481 or 1482 music is found printed with type. In 1473 a few notes were printed by C. Fyner at Esslingen. The principal use of music was in service books, and it was always printed in two impressions up to the end of the fifteenth century. The notes are generally in black and the stave lines in red. The earlier printers either left a blank space for the rubricator to write in the music, as in the 1457 Psalter, or in a few cases printed in the stave lines, leaving the notes to be added later by hand.

A further addition to the resources of the art was the cutting of Slavonic type, which is found in at least two varieties in Cracow in 1491 and at Cettinje, in Montenegro, before the close of the century. A Secretary type following closely the French law hand is found used at Paris and Rouen in the last decade of the century. A Rouen book printed for Richard Pynson, of London (Statham's Abridgment) is a good specimen of this type.

During the last few years of the century printing presses were established in Portugal, Denmark, Sweden, and Montenegro.

We have a picture of the printing press as improved by the close of the century in a "Dance of Death," printed at Lyons in 1499. A considerable change is seen from the plain screw-press of the earliest printers. It has assumed the familiar form of the wooden hand-press known to all. There is certainly a tympan. As to the frisket, it is distinctly probable that this valuable addition to the press was the invention of some one in the office of Schöffer at Mainz. It is most likely that the diminution of the number of pinholes in the sheet which occurs in the very early seventies is due to this addition to the press.

At the close of the fifteenth century the printer had almost emerged from the experimental stage. The press had assumed the form it was to hold with very slight alteration for 300 years. Books could be printed in Roman, and many varieties of Gothic types, in Hebrew, Greek or Slavonic letters, and music type (in two printings) was constantly used. Coloured inks were known, although very sparingly used. The technique of book-making had almost reached its height. The early books were without titlepages, tables of contents, pagination, imprint, signatures and illustrations. By the year 1500 all these had been introduced, and if they were not always used it was not because they were not known.

The Sixteenth Century.

With the opening of the sixteenth century the art enters upon a period of steady progress. It is true no great inventions either of machinery or methods were introduced, but the increase in the number of works issuing from the press was steady throughout the century.

The most noticeable change is the reduction in the size of books generally, and this occurred quite early in the century. As books became more popular and cheaper they naturally became smaller. The pocket volume, rare almost to non-existence in the fifteenth century, was almost common in the sixteenth. The small octavos and quartos were well in the majority. Even the folios were less unwieldy, and the enormous volumes of the past were almost unknown by the end of the first decade.

During this century it is remarkable to notice the enormous spread of the press as well as its activity just referred to. During the years 1501–1520 no less than twenty towns in Germany set up presses for the first time. In Italy,

during the whole century, no less than 100 towns set up presses. In England the progress was not so apparent. Only twelve towns set up presses during the century, and most of these attempts expired before its close.

The struggle between the Roman and Gothic types was resumed early in the sixteenth century, and a third competitor entered the lists in the shape of Italic. It was cut for Aldus at Venice, it is said, from the designs of Francia and modelled upon the handwriting of Petrarch. Aldus obtained a privilege for ten years for the sole use of this type-face, and it was first used in the Virgil of 1501. The success of the Aldine Italic at once produced imitators. Forged editions were issued at Lyons, and printers elsewhere produced varieties of the type. As a result of the struggle between the Roman and the Gothic, the Roman began to gain ground in the Latin countries, while Gothic still remained supreme in those of Germanic origin. There began in 1509 that semi-scientific discussion of the proportions of print letters by Paccioli which was carried on by Dürer, Geoffroy Tory, and later by Moxon, which has lasted until our own day, and has produced such little real results. The real problem is to design a fount of type in such a way that whatever combination of letters is arranged no single letter will stand out from the rest. This test should be applied to any type which is put forward as an artistic triumph. Whether to these investigations should be attributed the cutting of some excellent Roman types in France is uncertain, but it is sufficient to say that such types were cut and used for many years. Roman type was introduced into England in the early years of the sixteenth century and used first by Richard Pynson.

There were also cut, during the century, founts of Arabic, Syriac, Armenian, Ethiopic, Anglo-Saxon, Irish and music types. The only one of these which needs a word of explanation is the music type. In the fifteenth century music had been printed in two workings, the notes and stave at different impressions. The new type was of a different character. Each note was cast together with the piece of stave that belonged to it, so that the stave line appeared to a close observer to be broken into as many pieces as there were notes. This system was hardly ever used (if at all) for printing the Plain chant or liturgical music, for which the old method of two printings was retained.

One extraordinary variety of Gothic type may be specially mentioned. It occurs in "Theuerdank," an epic poem celebrating the Emperor Maximilian's wedding journey to Burgundy. It was probably composed in great part by Maximilian himself. Printed by Schönsperger, of Augsburg, it was published at Nuremberg in 1517. A special fount of type was cut for it by Jost Dienecker, of Antwerp, with enormous flourishes, especially to the letters "g" and "h"; for use when these letters occurred in the first or last line of the page. Many authorities believed the whole book to be cut on wood.

The use of coloured inks in the sixteenth century was very slight. It was confined almost entirely to red, used as in the previous century principally for service books. The various shades of brown and bistre were used by the chiaroscuro printers in Italy and Germany, but any real colour printing is almost unknown.

This century may be described as the golden age of the wood-cutter. In the first half especially, numbers of great artists were producing work for book ornament and illustration. Basel, Nuremberg, Florence and Lyons are the four towns that stand out as producing some of the finest work. There is little doubt that soft metal blocks were also used, and these were produced in the same way as woodcuts.

Copperplate engraving and printing had been invented in the early part of the fifteenth century, but retained its special character, only a few books being illustrated in this manner. The use of engravings during the sixteenth century in connection with letterpress printing increased to some extent, but the woodcut retained its supremacy, and only towards the end of the century do we find any effective competition. The earliest copperplate work produced in England belongs to the period about 1540.

The printing press is supposed to have been improved about the middle of the sixteenth century by a printer named Danner of Nuremberg, who is said to have introduced a metal spindle, in place of the wooden one used up to that time. It is true that some improvement must have been made to render the press more rigid, as we find the smaller type and more delicate woodcuts used at this time coming out quite sharp and clear.

In the technicalities of bookwork the printer advanced considerably during the period under discussion. The titlepage, which only appeared occasionally in the previous century, and then only in the label form (with one or two prominent exceptions), became an integral part of the book, and the colophon necessarily decreased in

importance. Woodcut initials and borders were quite common.

The sixteenth century is not only noticeable for the great expansion of the press in Europe previously referred to. It was also the period when Asia and America received and practised the art. In India (at Goa) and in Japan the Jesuit missionaries introduced the printing press, and in Mexico an offshoot from the press of Cromberger in Seville was working before 1540.

The Seventeenth Century.

With the opening of the seventeenth century a period begins in which the art of printing continues the process of degeneration from its artistic beginnings, which was seen at the end of the previous century. It is a period of great happenings in political life, of revolutions long drawn out in England and France, and these inevitably left their impress upon the craft. The pamphlet, very little used in the fifteenth century, and only making a sporadic appearance in the sixteenth century, mostly, of course, in connection with the Lutheran controversy, became one of the normal methods of publicity, and the newspaper, the genuine periodical, not the mere paper of news, made its appearance. Old and damaged type was used, and the Dutch founders, who supplied a large portion of the demand for new type, had no type designers worthy of the name in their employ. Here and there the old punches are rediscovered and founts of type cast from them, and books can be found which preserve some of the older traditions of beauty and proportion. The Roycroft Polyglot Bible is one of these books. The Roman type used in the preface is that used by John Day, the famous London printer of the sixteenth century. There is no new Roman type to which attention can be drawn during the period under discussion. To the types known before 1600 there were added Coptic and Samaritan. There was little change in the methods of printing music, although engraving was occasionally used. The number of Hebrew presses increased considerably, especially in Eastern Europe. The most important Hebrew fount cut in England was that for the London Polyglot in 1657, and this incurred considerable criticism. In Greek work this country has at least one production to be proud of in the Eton Chrysostom in eight volumes and in folio. This work, although the types were imported (or perhaps because they were imported), takes rank with the finest Greek printing. The type is similar to the Greek of the Stephanus press.

The best printing done in England during the seventeenth century was probably that in black letter. Acts of Parliament and proclamations were printed in this letter up to quite recent times, and the Old English or English Black, which had got quite away from the Fracturschrift of the Germans, and the Flamand of the Dutch, assumed characteristics of its own which rendered it quite a handsome letter.

Joseph Moxon attempted to draw up rules for the scientific design of Roman type, but they were unsuccessful, and, in fact, were more adapted to signboards than type. Moxon praised the Dutch letter, and probably imported a great deal. It may be said that there was no indigenous Roman in England during the century.

The reason for the want of enterprise in English typefounding was the restrictions imposed upon the trade. By the Star Chamber of 1637 the number of founders was limited to four, and a commission, consisting of the Archbishop of Canterbury or Bishop of London, with six others, was appointed to fill any vacancy. Free importation was the order of the day from 1640 to 1643, and from 1643 to 1662 the trade was free of restrictions. Owing to the Civil War this did not help it much, and in 1662 an Act reimposed the restrictions of the Star Chamber Decree of 1637 (cap. 27).

In France the characters cut during the previous century still held their own, and the Elzevier Bible, although printed in Holland, is a good specimen of the finest French work of the period. Towards the close of the century a new type was cut and used largely, which showed a degraded face from the fine models of the past, and formed a link between the early types and the modern effeminate French face.

Germany and Scandinavia were by this time the only countries to retain the use of the Gothic letter for ordinary printing.

There are no typefounders' specimen books known of the seventeenth century, although several founders issued specimen sheets. But several type specimen books were issued by printers, and the two best known are Fuhrman, of Nuremberg, in 1616, and the Vatican press in 1628. Some copies of the latter are on grey paper.

The literature of the practical side of the art begins in the seventeenth century.

The English typefounder and printer, Moxon, was the first to issue a complete treatise on everything connected with the art. So good

was it that at the end of the eighteenth century it was republished as an original and up-to-date treatise. Several books giving schemes of imposition were also issued.

A few words must be devoted to the earliest newspapers. The English *Mercurie* of 1588 has been proved to be a forgery, and the first English newspaper with a definite title has been identified as the *Weekly Newes* of 1622. Newspapers were issued earlier than this in Germany and Holland, the *Frankfurter Journal* and the *Nieuwe Tijdinge* of Antwerp being among the earliest. All newspapers of the Civil War period were in a small quarto, the foolscap folio size not becoming common until after the Restoration.

The press during the seventeenth century received a general overhauling and improvement at the hands of Blaeuw of Amsterdam. The exact improvements he made it is impossible to specify, as Moxon, who gives illustrations of both the new and old presses, only describes the new.

Finally, as regards the seventeenth century, it must be noted that printing was introduced into New England in 1640, and that in all countries which were comparatively free from the stricter press laws provincial presses became more and more numerous.

The Eighteenth Century.

We now come to the last 100 years of the period I am dealing with. In many respects it is the most important, as although it did not see the great inventions which were to follow so soon, yet the development of the great industrial revolution was steadily forcing the craft towards its reorganisation as a machine industry. It will be difficult to do more than mention any of the movements on the Continent, as our attention must be concentrated on the English developments.

In 1702 the first London daily paper appeared —the *Daily Courant*. There had been a few daily numbers of the *Post Boy* in the 1680's, but the *Courant* was the first genuine daily paper. From that day the daily paper has been always with us. Whether the daily paper of 200 years ago had more news than that of to-day, or whether the censorship was working overtime then as now, it is difficult to say, but the limitations of the press at that time only gave the printer two foolscap folio pages to fill, and so there was not that wild desire for copy which characterises his descendant of to-day.

Turning to type, the Dutch typefounders were still in the ascendant, and Watson, the well-known Edinburgh printer, boasted in 1713 that all his type and ornaments were Dutch. An improvement was, however, on the way. William Caslon, the reviver of English type-founding, was born in 1692, and served his apprenticeship to an engraver of gun-barrels in London. When he started in business for himself he added the engraving of bookbinders' punches to his other trade. These were seen by the printer, John Bowyer, who introduced Caslon to James, the typefounder. After studying the art, Caslon set up in business as a typefounder about 1720. His first type specimen sheet was issued in 1734, and this contains the famous Caslon Roman types which form the model for all the standard book types of to-day. They were an instantaneous success, and until quite late in the eighteenth century were the leading style. They then dropped out of sight, and later we shall see how they came to the front again.

A great rival of Caslon was John Baskerville, of Birmingham, who was typefounder and printer, and who designed his own types and printed from them. His Romans were good, but somewhat more stilted than Caslon's, and his manner of printing and hot-pressing gave them a slimness of which all people did not approve. Baskerville's great triumph was his set of Italic capitals. These are beautiful in outline and effective in combination. His first book was the Virgil of 1757. Although Baskerville made a success artistically, his types never really became popular, and after his death they were sold *en bloc* to Beaumarchais for his printing office at Kehl. Their history after their use at Kehl is misty in the extreme, and only recently it has been rumoured that they have turned up in one of the largest provincial French printing houses.

The example of Baskerville led to imitators abroad, of whom the most famous was Bodoni, of Parma. His work retained the simplicity of Baskerville without the artistic touch of the English printer. Bodoni became printer to the Grand Duke of Parma, and his specimen book shows an endless series of Romans, Italics, Greeks, all on the most magnificent scale. His Greek Homer in folio is one of the most magnificent works ever produced. But all his magnificence does not seem to impress. His paper is too white, his ink is too black (if that be possible), and his type is too scientifically correct to please.

In Scotland the Foulis press produced some fine editions from type cast by Dr. Wilson.

When we turn to France we find all the greatness (typographically speaking) of the previous centuries departed. French Roman types had degenerated greatly. An attempt was made by Didot to follow the examples of Baskerville and Bodoni, but his attempt was poor in comparison, and French types resumed their downward course. This is not to say that there were not fine books and fine specimens of printing produced in France in the eighteenth century. There were, but there was no great revival such as took place elsewhere, and then in 1789 the Revolution diverted all printing to the pamphlet and the newspaper.

The eighteenth century did not see coloured inks used freely in connection with letterpress printing, but many processes were invented and used for producing coloured prints. For the detailed history of these I must refer to my paper read before the Society in February last.

Book illustration of the eighteenth century is very mixed. Copperplate, in conjunction with type, even on the same page, is common. Woodcuts were at their lowest ebb until Thomas Bewick revived the art by adopting the graver as his tool instead of the knife, and using the end of the grain instead of the plank. By this means he obtained a delicacy of line which enabled him to give a world of detail even in the smallest vignette. His work rescued wood and placed it in a position successfully to rival copper.

A word must be said as to the spread of the press. This may almost be said to be universal. In every part of the world, by the end of the eighteenth century, the press had penetrated. Even in England the provincial press began to bear some relation to the importance of the various localities. A feeble attempt on the part of the Government in 1793 to insist on the registration of all printers did not succeed, but before the end of the century it became tolerably common for the printer's name to appear on his work. For many years it had been the exception rather than the rule, perhaps because of the rigid press laws.

And now, as to the printing press itself. We have seen it as a simple screw-press used by the earliest printers, developing within a very few years into the wooden hand-press complete with rolling bed, tympan and frisket. We notice in the earliest pictures the inking balls of the pressmen. Now at the close of the eighteenth century, 350 years after the first printer sent the first proof to press, we leave the press still wood, still with the slow motion that only allowed the quickest pressman to get 300 pulls in a working day, and still with the inking balls of the early days. To convey an idea of the method of the printer of this time I give a list of the operations necessary for making one impression:—

1. Inking the balls, or, as at present, the roller.
2. Inking the form.
3. Laying the sheet on the tympan.
4. Flying the frisket, and folding it and the tympan down on the form.
5. Running in the form under the platen.
6. Taking the impression by depressing the platen.
7. Running out the form.
8. Lifting the tympan and frisket.
9. Releasing the sheet and placing it on the bank.

It will always astonish those who examine this practical side of the history of printing that with such slow methods the great books, and still more the great newspapers of the eighteenth century could ever have been produced.

THE DAIRY INDUSTRY OF GREAT BRITAIN.*

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For the last twenty years the dairy industry in Great Britain has been steadily growing in importance, and dairy farming has to a large extent taken the place of other kinds of farming.

This may be accounted for by the increased consumption of milk by the populace, which has been and still is being educated to realise the high feeding value of milk, which has become more and more part of the national everyday diet of adults as well as children.

An estimate made some time ago put it that the annual increase in the consumption of milk amounted to 5,000,000 gallons, but it is doubtful if such will continue the annual figure if the retail price of milk is unduly increased. But whilst people are learning more concerning the value of milk in their daily dietary, it is as yet difficult for the majority to realise that in proportion to its cost it is the cheapest food obtainable. Thus whilst the price of most foods has gone up recently, that of milk also has been slightly increased. An increase in the price of milk, however, is generally resented by the public, which resentment is apt to show itself in the form of a decreased consumption. People would not, however, endeavour to effect economies in their living expenses by cutting down the quantity of milk purchased if they possessed a proper knowledge of the feeding value of this food

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in proportion to its cost. Undoubtedly no other food can be obtained in Great Britain at as cheap a rate, taking into consideration its food value.

Now of what value is the dairy industry of Great Britain at the present time? The answer is supplied in some figures recently published by the Statistical Department of the Board of Agriculture, by which it is shown that the estimated quantity of milk produced, after allowing for the amount used for calf rearing, is 1,208,000,000 gallons per annum.

As to the manner in which this milk is dealt with, it is calculated that 70 per cent., or 850,000,000 gallons, is sold as milk, whilst the value of the dairy products respectively as sold by the farmers is—

£24,963,000 for milk,
£590,000 ,, cream,
£2,940,000 ,, butter,
and £1,400,000 ,, cheese.

These figures show very clearly the great value to the farming industry of the milk sold for consumption in the towns, whilst the total sum realised for the milk and its products is about the same as that realised for the wheat, barley and oats grown. Furthermore, it nearly reaches the sum obtained for cattle sold as meat.

It would be interesting and instructive to compare these figures with similar estimates for, say, two decades back, but unfortunately this cannot be done, such returns not being available. What has happened, however, in recent years is that dairy farming has steadily been taking the place of corn growing, and arable land has been turned into pasture to suit the altered class of farming, thus resulting in an ever-decreasing area of cultivated arable land.

Where corn growing has not been found to pay, dairy farming has generally been substituted, and it has also largely taken the place of fattening cattle—a class of farming which has not been very remunerative of recent years, owing to the large importation of foreign and colonial meat that has come into operation.

Now whilst the importation of butter and cheese from abroad largely influences the value of these commodities as produced in Great Britain, there is practically no importation of milk to affect the value of the new-milk trade. The populace of Great Britain, whilst existing and being dependent chiefly on foods imported from abroad, is fortunately able to obtain a supply of home-produced milk to meet its requirements fully. Small quantities of fresh milk are imported from countries within easy reach of the British Isles, but the quantity is negligible and the trade at present shows no prospect of developing.

Milk-selling has been described recently as the sheet-anchor of the English farmer, and certainly it has assisted him to an extraordinary extent when other systems of farming have failed. He realises that he is free from the competition created by imports from abroad that exists in the case of most other commodities, and thus is able to develop his trade without the fear of having to compete with others who can produce milk at cheaper cost. The retail price in towns varies from 1*s*. 2*d*. to 1*s*. 4*d*. per gallon. In many large towns up to within about four years ago milk was sold at 1*s*. per gallon all the year round, but it is now generally sold at 1*s*. in summer and 1*s*. 4*d*. in winter, making an average price of 1*s*. 2*d*., though in many of the large towns it does not vary from 1*s*. 4*d*. all the year round, and 1*s*. 8*d*. per gallon is charged for the best-class trade in London.

Generally speaking the wholesale price of milk throughout the country may be taken as about 7½*d*. per gallon net to the farmer throughout the year after the freight charges have been deducted. About 8½*d*. net is obtained in the winter and about 6½*d*. net in the six summer months. The cost of transport in the country generally may be taken as 1*d*. per gallon, which conveys the milk up to 100 miles. Comparatively little milk travels short distances so as to secure the ½*d*. per gallon rate which conveys it for twenty miles.

It is not the same with the butter and cheese trade, however, for these have to compete with imports from very many parts of the globe. The imports of butter into Great Britain are valued at £24,000,000 and those of cheese at £7,000,000, which totals more than the whole amount realised for milk, cream, butter and cheese produced in the country. The cost of production in most countries from which butter and cheese are received is much less, owing to cheaper land, cattle, feeding, etc.; hence the development of the milk trade in Great Britain at the expense of the manufacture of cheese and butter, as shown in the figures previously quoted.

The question arises as to what is being done to cope with the increased demand for milk and the possibility of the demand being greater than the supply. As previously mentioned, more and more arable land is being converted into pasture, which is the main requirement for dairy farming; but apart from this must be considered the number of stock capable of being carried by the total amount of land available. Farming in Great Britain is still regarded as one of the less important industries, though there are many movements on foot at the present time to make it more productive and to increase the area of land available for agricultural purposes, by bringing under cultivation soil which at present is more or less unproductive. If, however, these points are left out of consideration, and it is assumed that the present available land is carrying practically all the stock it is capable of doing, which we think is by no means the case, there is still a means of increasing milk production. This is by means of increasing the yielding capacity of the dairy cows, or, in other words devoting special attention to breeding and selecting animals for high yields of milk. A great deal of work is now being done in this direction both by individual dairy farmers and public bodies—work that ten years ago merited but little attention. If the average yield per cow, as is estimated for

Great Britain, is only some 350 to 400 gallons, then it follows that much improvement is possible. Milk records are being carried out by various county councils and dairy associations, the results of which show the quantity and quality of the milk yielded annually by each individual cow in the herd, and this information enables the farmer to retain only the cows which give satisfactory results.

In Scotland a number of dairy societies have been started and have been in operation some five or six years, with the result that milk record schemes of great value have been obtained, and much growth in this is being continued. It is found that in most herds the variation in the annual yield per cow is great, for whilst the poorest animal may give 350 gallons or less, the best may be yielding 1,000 or perhaps more. Now the cost of keeping and tending an animal yielding a large quantity of milk does not much exceed that of a poor cow; hence, if only good cows of tested capacity are kept, as much as 50 per cent more milk may be obtained from a similar number of cows.

Most dairy farmers, even men who have been engaged in the work for many years, seldom know the milk yield of each cow in their herds, and milk records have shown as wide a difference between two herds on adjoining farms as 200 gallons per cow. Thus the farmer whose herd averages 600 gallons per cow per annum may look forward, by exercising care in selecting his cattle, to increasing the yield to 800 in the course of a few years.

Numerous dairy farmers, however, do not breed their own stock, but instead buy cows which they retain for one, two or three years, and then sell them off fat to the butcher. The calves of such animals are usually also sold to the butcher, and this system of dairy farming tends to reduce the quantity of milking stock in the country, and many of the best dairy cows are thus lost. Such may be considered a very extravagant method of dairy farming, and to the farmer in this case milk records do not appeal, as he does not keep his cows a sufficient length of time and does not retain any of the progeny, even of the best ones.

The favourite breed of dairy cattle throughout the country is the Dairy Shorthorn—an animal of Shorthorn type but not of pedigree strain. A good animal of this class may be valued at from £18 to £25.

The factory system of dairying is not extensively carried on in Great Britain, but in Ireland there are a very large number of creameries, and butter-making on Danish methods is practised. In England the large centres of population require the milk for consumption, but in Ireland there are but few large towns, and their requirements of new milk are limited, allowing for an extensive manufacture of butter. Where factories exist in Great Britain they usually engage in all branches of the dairy industry, selling milk to the towns whenever possible and making cheese and butter. The former generally gives better returns than converting the milk into dairy products; hence the manufacturing periods are chiefly when milk is plentiful and the markets overloaded. Of course in many cases there are factories where cheese or butter is manufactured and milk-selling not undertaken, but these are becoming fewer and exist chiefly in the more isolated districts. The greater part of the butter and cheese produced is still made on the farms, but even this is rapidly changing, and where farmers formerly manufactured the milk at home they are commencing the sale of the milk.

A number of factories on co-operative lines are being established. Such factories, started and run by the farmers themselves, are proving a very satisfactory means of regulating the milk trade, as when there is a surplus of milk it need not be placed on the market and so lower prices, but can be converted into cheese and butter. Further, where the milk is manufactured at a factory it is possible to produce an article of more uniform quality than is the case at individual farms, and the smaller dairy farmers are thus enabled to obtain a better return for the milk produced on their holdings.

Whilst it is still a fact that the finest quality butter and cheese is produced at the best farms, it is nevertheless true that the bulk compares very unfavourably in quality with that turned out from the factory where skilled labour and scientific methods are in vogue. Much expenditure has been made in teaching butter- and cheese-making for many years past, and doubtless some general improvement in farm-made dairy products has resulted, but on the whole the return has been small in proportion to the expenditure involved. It has indeed become generally recognised that it is better for a group of farmers to start a dairy together, properly equip it and employ the best skilled labour, rather than continue the manufacture of dairy products at home. Better means of marketing are possible, and generally better financial returns are the result.

For the protection of the public, various laws affecting the production and sale of milk have been put into operation recently, and further restrictions on the sale of milk will come into force when what is known as Mr. Burns's Milk Bill, at present before Parliament, becomes law. Parliament, after many years of apathy, has become alive to the need that the nation has of supplies of pure wholesome milk. It doubtless realises that the health of the nation depends greatly upon supplies of pure milk, especially as milk has now become so commonly used in the daily dietary of the great majority, and, moreover, it is the chief food of children, who need most protection.

Following upon the reports of the Royal Commission on Tuberculosis, whose investigations and findings during the last twenty years have shown that tuberculosis or consumption in human

beings is largely caused by tuberculous milk and meat, an order came into force on May 1st by which all tuberculous cattle must be notified. Such cattle are to be examined by veterinary inspectors appointed by the county councils, and on their recommendation all obviously tuberculous animals and cows suffering from tuberculous udders will be slaughtered, compensation to the extent of one quarter of the estimated value of the animal being paid to the farmer where advanced tuberculosis is discovered. Where tuberculosis is manifest but not advanced, three quarters of the value will be paid—in each case half the cost of the valuation and examination to be deducted.

This is an important move in protecting the public, especially children, from tuberculous milk and meat, as unfortunately a fairly large percentage of tuberculous milk is now marketed; indeed, some recent figures of extensive analyses made of London's milk supply showed no less than 10 per cent. of the supply as containing the tubercle bacilli. Municipal authorities can exercise powers to prevent the entrance of milk in towns from any source when it is proven to be tuberculous, but such powers are seldom used. Whilst the Tuberculosis Order will doubtless in a few years result in the killing off of most badly tuberculous cattle, there will still remain the animals that are apparently healthy but are really tuberculous as shown by the tuberculin test. In several instances private enterprise has embarked upon the supply of milk solely from cows which have passed the tuberculin test and are kept periodically tested, which is the only sure way of obtaining a milk supply guaranteed free from tubercle germs.

This alone is not the only part of the scheme, as if milk is obtained pure from healthy cows it must not be allowed to get contaminated from human infection afterwards and before it reaches the consumer, and to prevent this it must be handled and distributed under proper hygienic conditions. There is a minimum Government standard of quality which specifies that if milk contains less than 3 per cent. of fat and 8·5 per cent. of solids not fat it is presumed, until the contrary is proved, that the milk is adulterated.

The law also prohibits the use of any chemical preservative whatever in milk, though harmless colouring matter is not debarred. Recently, too, the use of preservatives in cream has been restricted, and it is now illegal to add any preservative whatever to cream containing less than 40 per cent. of fat. If cream containing over 40 per cent. of fat is preserved, only borax, boric acid, and hydrogen peroxide are permitted to be used, and all receptacles in which such preserved cream is sold must have affixed to them a label printed in letters of a specified size varying with the size of the vessel, stating the preservative used, and if borax or boric acid or both be present, the percentage expressed in terms of boric acid must be stated on the labels. Restaurants and refreshment rooms serving preserved cream are required to display notices to this effect.

THE TURKEY.

The approach of Christmas concentrates public attention on the turkey. The curious identity of the name with the realm of the Ottoman Sovereign, with which, however, the bird has absolutely nothing to do, has rather obscured from public recollection the fact that the bird is distinctively American, and that its first known appearance on any festive board took place in 1519, when Cortez reached the land of the Aztecs and was entertained with royal splendour by Montezuma, and roast turkey figured as one of the most important of the dishes set before the Spanish invader. It was found that the Aztecs had domesticated the turkey to a large extent, and that it was also plentiful as a wild fowl. North of the Rio Grande the bird was equally well known, and Coronado, on his expedition through what is now Texas, Arizona, and New Mexico, found it among the cliff-dwelling Indians and other tribes which he met en route. Among some of the Indians the bird had been known for centuries, the flesh being much appreciated as delicious food, while the feathers served as a favourite adornment for headgear. When the English occupied Massachusetts they found wild turkeys in abundance. In fact, the turkey had its habitat over all that part of the continent where grew its favourite food, Indian corn. From the New World the bird was introduced into Europe by returning Spanish adventurers, and it is possible that more distant States to which it was exported concluded that, like so many other strange things this new fowl came from Turkey and the Golden East. Another explanation volunteered is that the bird may have named itself, as the call of the turkey-hen to her chicks sounds like *tur-r-rk, tur-r-rk.*

The wild turkey of North America, as the Bulletin of the Pan-American Union remarks, is without doubt, the progenitor of all the varieties now spread over other parts of the world. Ornithologists in general hold the aboriginal stock included three varieties, viz., the North American, the Mexican, and the Honduras (*Ocellata*). The bird found in certain forest regions of South America and called curassow, though sometimes designated as the South American turkey, is in reality a member of a different family.

The Mexican turkey, wild throughout the republic (*Meleagris Mexicana*), is short in shank, while the feathers of the body are metallic black shaded slightly with bronze, and all the feathers are tipped with white. The Honduras turkey (*M. ocellata*) is found scattered over most parts of Central America. It is extremely wild, and has a freer flight than those of the north, and is the most beautiful in colouring of all. The ground colour of the plumage is a beautiful bronze green, banded with gold bronze blue, and red with some bands of brilliant black. It can neither be bred successfully nor domesticated. The North American (*M. Americana*) is the original species of the eastern United States. Its colours are black, beautifully shaded with a rich bronze, the broad plumage dark bronze,

brightened with a lustrous finish of copper gold. In the United States six standard varieties of the domesticated variety are recognised and bred. The differences are chiefly in size and colouring.

The turkey, mindful of its former wild state, will not thrive in narrow confines or closed houses, but prefers room and exercise, and a wide range in which to peck about for food. He is not of a bold and adventurous disposition, flies ponderously and with great effort, and only when very much frightened. Nevertheless, as a sprinter he is said to be a great success, and as capable of outstripping a racehorse.

Cortez, so we are told, brought the fowl to Spain in 1520, and as an addition to the feasts of the nobles it was so widely appreciated as to be introduced into all European countries. In France his first appearance seems to have been on the occasion when Charles IX. married Elizabeth of Austria on June 27th, 1570, the *pièce de resistance* having been imported all the way from the then village of Boston in the wilds of America. Time was, they say, when a turkey in America could be bought for 25 cents, or a shilling, whereas nowadays the flesh costs that much per pound. As a favourite dish at Christmastide and on Thanksgiving Day in the United States the turkey is too well known to need comment.

THE "QUARTERLY REVIEW" AND BRITISH CHARITIES.

For the purpose of providing its readers with an earlier review of the various questions concerning the Great War, the usual January number of the *Quarterly* is being published in two parts, of which the first has appeared this month. The second half will be issued as usual in the middle of January.

At the end of the number, and as an introduction to the pages devoted to the advertisements of charities, the *Quarterly* prints the following forcible and eloquent appeal on behalf of a number of benevolent institutions, and of others in like case:—

"The strain is still upon us, is heavier still, is bound to grow. The burden of the greatest war in history already presses, even fiercely, upon all classes and conditions. The heroism of our soldiers and sailors, not to forget the splendid devotion of the men and women who have gone to the fighting places to counteract the cruelties of war, has drawn forth a fine response in service and generosity. Meanwhile, the institutions and charities at home, whose work is more necessary than ever, and whose sources of revenue—at the best not too lavish—have been dangerously re-[illegible]ted through the counter appeals, are endeavouring to continue. They must continue—it is the only word—and the only way to make their position and influence assured is for the stream towards them of donations and subscriptions to keep up."

Then there follow the advertisements of the following well-known hospitals and benevolent institutions: Friends of Armenia, Hospital for Sick Children, London Orphan Asylum, Medland Hall, Royal Alfred Aged Merchant Seamen's Institution, Shipwrecked Fishermen and Mariners' Royal Benevolent Society.

While endorsing this well-timed appeal on behalf of charities who are suffering from the diversion of their usual funds to the urgent needs of the many sufferers from the war, it may be permissible to point out that not charitable institutions alone must lose from the necessary depletion of the sources of supply on which they have to rely. The opportunity may fairly be taken to ask the Fellows of this Society to remember that it also relies wholly for its existence on public support, that it has for years been doing useful national service to education, industry, commerce, and the arts; that its work will be required more than ever when the troubles of war have passed away; and that it has no funds beyond the moderately accumulated surplus of recent prosperous years.

It seems, therefore, not unreasonable to appeal to them and through them to such of their friends as can afford to do so, to help the Society to husband its limited resources, so that its capacity for usefulness may not be crippled by too serious a diminution of its revenues during the short season of adversity which it, in common with the rest of the nation, is fated to endure.

POULTRY AS FARM STOCK.*

The increased production of food supplies is a most important consideration at the present time, and among perishable foods eggs and poultry hold a leading position. Hitherto upwards of 40 per cent. of the annual consumption of these products in the United Kingdom, valued at perhaps £25,000,000 yearly, have been imported. As three-fourths of these supplies are affected by War conditions the need is greater than ever for development of our own resources.

The poultry census of 1908 made it clear that upon the farms and holdings in England and Wales over one acre in extent there were 595 head of adult poultry (inclusive of ducks, geese, and turkeys) per thousand acres of cultivated land. These two countries could maintain three adult fowls per acre without displacement of any other stock or interference with any crop. In addition there are large areas of rough grazings and open lands upon which poultry could profitably be maintained and reared.

Any advance in the cost of foodstuffs is much more than compensated for by the advanced values of eggs. When conditions have returned to the normal, there is no probability that the demand will decline.

* Special leaflet issued by the Board of Agriculture and Fisheries.

Points for the Consideration of Farmers.

Every farmer should increase his stock of poultry as opportunity arises. All healthy, well-grown pullets should be retained as breeding or laying stock, while suitable male birds should be selected for mating later on. In order to economise the food bill, all surplus cockerels or hens should be gradually disposed of except where the hens are likely to be useful as sitters and mothers.

When the stock of poultry on the farm is increased the birds should be distributed over the land and should not be allowed to congregate round the homestead, as that would involve over-crowding and tainting of the soil. Poultry should be moved over the farm in rotation; this would enable full advantage to be taken of the value of the manure distributed by them. (A hundred large fowls will produce four tons of moist manure in a year, worth for many purposes 30s. per ton.)

Apart from the work of hatching and rearing, which should be carried out nearer home, the cost of the management of distributed flocks of poultry is not great. In this direction women and the older girls and boys may be employed. Among farmers' families there are generally some members to whom this work may be committed.

Poultry distributed over the farm would find a large part of their own food, more especially if the position of poultry houses is changed from time to time. Except on poor land or in winter it is only necessary to supply food once a day, preferably in the afternoon when the eggs are gathered. Grain is to be preferred if available. Soft food may, however, be given to effect economy, while household scraps, vegetables, and roots may be used in preparing the mash. Even with an advance in the price of foodstuffs the cost of feeding fowls on farms should not exceed 3s. 6d. to 4s. each per annum.

What Farmers should Produce.

In the majority of cases egg production will be found most profitable, as the imports of eggs are much larger than those of poultry. In 1913 the eggs received from other countries were valued at £9,590,602, and poultry at £992,463.

In one direction farmers can render most important service—namely, by hatching and rearing birds suitable as breeding or laying stock for sale to small holders, allotment holders, and other poultry keepers. In many instances younger members of the family can undertake the work, and build up a connection which should, in the future, be very valuable.

Methods to be Adopted.

Distribution over the land involves the use of portable houses, by which mobility in relation to cultivation can be secured, and the manure produced will thus be utilised to the full. Unless it is desired to retain breeding pens near the farm buildings for special purposes, it is unnecessary to provide runs enclosed by wire netting. In fruit orchards fowls render great service by the destruction of pests which prey upon the fruit trees.

Portable houses can be built or purchased inexpensively. An excellent size is 6 ft. by 8 ft., and 5 ft. high to the eaves. Half of one side should be formed of wire netting, left uncovered all the time, as this ensures light and free circulation of air. To facilitate removal it should be upon wheels and have a wooden floor. Such a house will accommodate twenty-five adult fowls or forty growing chickens.

If eggs are available every hen that becomes broody should be utilised for hatching. In addition one or more incubators should be in use. The following suggestions are important in this branch of the operations:—

(1) As far as possible only selected hens which are over one year old should be used as breeding stock, hardy, active birds being chosen. Those may be mated with a vigorous, early-hatched male bird. Pullets should be kept only as layers until next year.

(2) Eggs to be placed under hens or in the incubator should be carefully selected. Those chosen should be well shaped, with strong shells, and slightly over the average size for the breed.

(3) Where eggs are the chief consideration it is best to mate only hens that have proved to be good layers, or those which as pullets began to lay early in the autumn. The male bird used should also be bred from a hen known to be a good layer. The aim should be to build up a flock with a good laying average.

(4) If table chickens are desired, selection should be from those which develop quickly and which carry an abundance of flesh.

Ducks.

Under normal conditions the raising of ducklings, for early marketing, is very profitable where the work is conducted satisfactorily. Farmers who have running streams or large ponds in which the ducks can find the greater part of their food, may be advised to keep flocks for the sake of the eggs produced, as these can be sold at good prices. Several lots of ducklings should be hatched, otherwise these birds will not prove profitable, as they are expensive to feed. Owing to economic reasons, the demand for ducks will be limited for some time to come.

Turkeys.

With few exceptions the larger farmers have hitherto failed to realise the profitable nature of turkey raising, which is not suited to small holdings as the birds require an abundance of range. It is possible that in spite of reduced imports for the Christmas markets, the demand may be much less than in previous years, and that prices may be comparatively low.

Farmers might take the opportunity of increasing the general stock of turkeys throughout the country. A larger proportion than usual of the young hens should be selected as soon as possible, giving them free range until next spring, and keeping them for breeding or selling them to other farmers for that purpose. As a rule it is

inadvisable to use yearling turkeys for breeding, but the present conditions are exceptional.

On the 14,513 agricultural holdings in England and Wales above 300 acres in extent, comprising 25 per cent. of the total cultivated land, if only one adult turkey were kept for every ten acres, there would be 673,676 birds all told. According to the poultry census of 1908 there were only 172,000 on all holdings above one acre in extent. There is, therefore, very great room for increase.

Geese.

As geese are unprofitable unless they can be fed cheaply, they are not recommended for ordinary farms. Much might be done on common or rough grazing land, where these birds would find their food during the growing stages, and provide a cheap supply for our markets.

Feeding Poultry.

On farms where poultry are at liberty, the birds will find a large part of their food. Much loss arises from supplying food too abundantly. Young birds must be fed until they are able to obtain food for themselves. Older stock should only be supplied with the limited amount of extra food which they may require. Small corn, green foods and roots grown on the place may be given freely. In case of shortage, cut steamed hay (clover hay for preference) is a valuable food; it may be dried off with a little meal. On dairy farms soured skim milk and butter milk are valuable foods for poultry, and may be freely used.

Home production would be greatly increased if agricultural labourers were encouraged to keep a few fowls, and if farmers gave permission for these to run over pastures or arable lands after the crops are harvested. If in this way each agricultural labourer were enabled to keep, say, ten fowls, production would be increased to a very considerable extent.

EMPIRE NOTES.

British Subjects in the United States.—In an article in *United Empire* of this month, on "Who are British Subjects in the United States?" some interesting figures are given, from which it appears that the estimated number of residents in the States who were born in the United Kingdom is 2,573,734, and the number who were born in Canada is 1,204,637, making a total of 3,778,371. Of the males of twenty-one years of age and upwards who have become naturalised, 770,094 from the United Kingdom and 271,762 from Canada have become full citizens, whilst 76,668 and 26,150 respectively have applied for their first papers. This means that about 65 per cent. of male English immigrants of full age and about 54 per cent. of Canadians become naturalised American citizens. This seems to show, and it is natural that it should be so from the closer proximity of their mother country to the States, that Canadians are more tenacious of their nationality than those who come from the British Isles. Applying these percentages to the whole British and Canadian-born population, and making considerable reductions for women who have married, it is found that there are, roughly speaking, about 700,000 persons who were born in the United Kingdom, and about 560,000 who were born in Canada, who are still British subjects, or an estimated total of 1,260,000. The children of these persons, at least of those whose fathers are British subjects, born in the United States, will be subjects of dual nationality. The British-born population is largest in the States of New York and Massachusetts, where 561,000 and 345,000 were born in the United Kingdom, and 120,000 and 297,000 in Canada, respectively. In the other States of the Union there are also large numbers of British-born subjects. In addition to these, there are 2,993,902 persons, born in the States, both of whose parents were born in the United Kingdom and 638,267 whose parents were born in Canada, or a total of 3,289,390, while there are 2,369,112 of whom one parent was born in the United Kingdom and 920,278 of whom one parent was born in Canada. Estimating that only half of these latter parents were males, and therefore capable of transmitting their nationality to their children, it is necessary to halve these figures, which gives a total of 1,644,645. By adding these numbers to the 3,778,371 persons born in the United Kingdom and Canada a grand total of 9,055,785 is reached, from which, however, must be deducted those who have become naturalised, and married women. The net estimated result gives the number of British subjects in the United States (the greater proportion of whom will be of dual nationality) as between seven and eight millions. From these facts the writer infers that the field for the activities of British patriotic societies in the United States is a wide one, and argues the possibility, by attention to this subject and to the opportunities offered at the present time, of drawing still closer the connection between the United States and Great Britain, and of still further promoting the amicable relations between the two countries.

Empire Generosity and Unity. One of the most striking features of Empire generosity and unity in the present crisis is the number and variety of offers and gifts received from some of the smaller colonies and dependencies of the Crown. In a recent number of the *West India Committee's Circular*, under the heading of "Practical Patriotism," reference is made to the offer of £20,000 by the people of Barbados, which, the writer says, "is in accord with the best traditions of that patriotic island, whose proud boast it is that its shores have never been sullied by an invader." In accepting the gift on behalf of the Government, Mr. Harcourt, the Secretary of State for the Colonies, suggested that the most practical form in which it could be sent would be in that of sugar. The Governor of Jamaica appropriately offers, on behalf of the people of that island, a gift

of sugar towards the expenses of the war, which has also been gratefully accepted. British Guiana has started a National Relief Fund, in addition to which the sugar proprietors of that colony, by accepting a price some four or five pounds per ton below the present market price for 60,000 tons of sugar, have made, indirectly, a gift of some £200,000 to the national funds. Trinidad has also opened a fund, and the Bahamas and Bermuda are contributing largely from public and private sources. Other gifts in kind besides sugar are being sent from the West Indies, consisting of oranges, grape-fruit, cocoa, and arrowroot. From Africa, Lewanika, Paramount Chief of the Basutos, sends money to the Prince of Wales's Fund. The Somali chiefs send offers of service, the Emirs of the Northern Provice of Nigeria contribute towards the military expenditure of the Nigerian Government, the Sultan of Sokoto sends a contribution to the Prince of Wales's Fund, as does Sierra Leone. The Falkland Islands and Fiji Islands send money to the Fund, while the latter is also preparing a small expeditionary force. The Maoris of New Zealand are keen to join the expeditionary force of that Dominion, and the Red Indians of Canada are giving money and personal service. Such contributions as these, and many more of a like kind, apart from the great gifts and services of India and of the self-governing Dominions, prove how strongly united the Empire is and how ready to support the Home Government in their great task.

Canada's Trade Outlook and the War.– A well-known American writer, Mr. J. O. Curwood, has been making a study of conditions in the West of Canada in relation to the war. He considers that the war may result in an era of prosperity to that country which it has never known before, not an era of estate boom but of development and growth that will mean practically a new Canada in the West. "For some time," he says, "Canada, if not really sick, has been on the eve of a serious kind of sickness, caused by the fact that her town and city population and values had too greatly outrun her rural population and values"—a statement which may be applied with some, if not equal, force to Australia, where the growth of the city has been far in advance of the rural district, greatly to the disadvantage of the country as a whole. In Mr. Curwood's judgment, the signing of peace will lead to an immigration movement that will amaze the world. After the Franco-German War in 1870, 200,000 Germans settled in three of the greatest American States—Nebraska, Minnesota and Iowa, which are now German-American. He thinks that where one German emigrated then five are likely to do so at the close of this war, but they will not go to the United States, as there are no fit lands open to them there. They, and numbers of emigrants of other European nationalities and of the United Kingdom, will make their way to Canada and South America. We should also say to Australasia as well, as to the Greater Britain of the Southern Seas there is likely to be a considerable movement when peace is concluded. In regard to the prospect of land values in Canada, Mr. Curwood says, "they must increase, and from now on they will increase through steady growth and development." He considers that a great deal of property had been over-sold and that certain places had consequently suffered, but he did not think this over-selling is so serious as some people believe, who forget that "every city that ever became a city had to pass through its period of boom days." This confident and optimistic opinion is largely confirmed by the position and prospects of Canada to-day, notwithstanding the strained monetary conditions from which it has recently suffered and the dislocation of trade, in some departments, occasioned by the war. It has been pointed out, in certain trade journals, that the feeling of pessimism which affected the country on the breaking out of the war has given place to a more assured and optimistic view, arising from the fact that, owing to Canada's inherent strength as a producing country, her inevitable losses in some lines may be more than counterbalanced by her increased profit from others, particularly from produce, which, for the next few years, must command high prices. Strenuous efforts are being made throughout the Dominions to encourage the production of all commodities for which a special demand may be expected. The immediate prospects appear, therefore, to be most favourable. The purchasing power of the farmers is largely increasing, and the appeal of the Dominion and Provincial Governments to put more acreage under cultivation has met with a ready response.

The Transcontinental Railways of Australia.—There are two transcontinental railways in Australia in course of construction—one from Adelaide *viâ* Oodnadatta and Pine Creek to Darwin, south to north, and one from Adelaide *viâ* Port Augusta and Kalgoorlie to Perth, east to west. The main northern line of South Australia terminates at Oodnadatta, and the line for Darwin at Pine Creek. These two termini are to be joined by a railway across the centre of Australia. Good progress, according to recent reports, is being made at the northern end of this projected line, but the line from east to west is being pushed on with much greater rapidity. The rail-head at the Kalgoorlie (Western Australia) end has reached 121 miles. The waterways have been completed to 72½ miles, the concrete work to 80 miles, and the telegraph line for 120 miles. The earthworks had been finished up to 125 miles, the work having been somewhat delayed by heavy cuttings at the 100 miles. On the South Australia side the rail-head is at the 122½ miles, where heavy earthworks have been encountered. A special deviation had therefore to be made, which is about completed. The waterways have been finished to 95½ miles and the telegraph line to 122 miles. The average number of men employed on the south to north extension

is 163, and in the east to west 1,679—1,067 at the eastern and 612 at the west end. The completion of these railways will mark an important advance not only in the railway communication of Australia, but in the development of the areas between the Oodnadatta and Pine Creek, and Port Augusta and Kalgoorlie, and also, in connection with the former, in the opening up of the Northern Territory, which for defence and trade purposes, will be of considerable advantage to the Commonwealth and the Empire.

Bounties to Australian Manufacturers.—According to a return made by the Commonwealth Minister of Customs, published on October 14th, the amount paid by way of bounties to Australian manufacturers during the financial year ending June 30th last, was £51,810 8*s.* These bounties were paid under the Manufacturers' Encouragement Act of 1908. Of this amount, £40,120 18*s.* 7*d.* was paid to G. & C. Hoskin, Ltd., of Lithgow, New South Wales, on pig iron made from Australian ore, and £7,135 13*s.* 2*d.* to the same firm for steel made from Australian pig iron. The remainder of the bounties paid under this Act, £4,553 16*s.* 3*d.*, went to Lysaght Bros. & Co., Ltd., Sydney, for wire netting made from British wire. During the same period a further sum of £13,975 4*s.* 7*d.* was paid under the Bounties Act, but in this there were 88 participants, the largest being F. W. Hughes, Ltd., of Botany, New South Wales, who received £9,083 17*s.* 3*d.* on wool tops, and Whiddon Bros., Ltd.. also of Botany, who received £3,622 4*s.* 11*d.* on wool tops. The sum of £343 17*s.* 3*d.* was paid to sixteen persons on tobacco leaf, for the manufacture of high-grade cigars; £317 17*s.* 8*d.* to forty persons on flax and hemp fibres; and £432 17*s.* 7*d.* to seven persons on dried fruits, except currants and raisins. Under the Shale Oils Bounties Act of 1910, the sum of £328 17*s.* 8*d.* was paid, £278 4*s.* going to the Commonwealth Oil Corporation for kerosene and refined paraffin wax, and £50 13*s.* 8*d.* to the British Australian Oil Co., Ltd., aslo for refined paraffin wax.

GENERAL NOTES.

Memorial Tablets.—The London County Council have issued three more of the pamphlets (Parts XL., XLI., XLII.) recording their work of indicating houses of historical interest in London. The distinguished persons commemorated are Cardinal Manning, Carlisle Place, Westminster; Anthony Trollope, 39, Montagu Square; Lord Tennyson, 225, Hampstead Road; C. H. Spurgeon, 75, Great Dover Street; Robert and James Adam, 4, Adelphi Terrace; and Benjamin Franklin, 36, Craven Street, Strand. Of these the brothers Adam and Franklin are, so far as the Society is concerned, the most interesting, from their association with its history. The account of the Adams contains some new information about their residences, partly supplied from the Society's old records. The note on Franklin records the queer mistake made years ago in the identification of the house, and circumstances which led to the correction of the error. Details of this little backwater of history have already been published in the *Journal* (Vol. LXII. p. 17).

Quantity of Food Required for a Vegetarian Diet.—At a conference recently held at Nice, under the auspices of the Société Végétarienne de France, it was stated that the following menu would afford sufficient nourishment for an adult worker:—

	Quantity.		Price per Kil	Amount
	Grams.	English ozs.	Cents.	Franc.
Cereals or Dried Vegetables . .	150	5¼	60	0·09
Fresh Vegetables	150	5¼	25	0·04
Potatoes . . .	300	10½	15	0·05
Bread	500	17⅝	45	0·225
Olive Oil . . .	60	2⅛	1·35	0·09
			Total . .	0·495
				(or about 5*d.*)

Gold Production in Australia.—The value of the gold produced in the Australian Commonwealth during the period 1851-1911 amounted to £536,196,981, contributed by the various States as follows: New South Wales, £58,760,846; Victoria, £289,663,989; Queensland, £73,739,851; South Australia, £892,810; Western Australia, £103,850,486; Tasmania, £7,245,982: Northern Territory, £2,043,017. The amount of gold produced in the Commonwealth in any one year attained its maximum in 1903, in which year Western Australia also reached its highest point. For the other States in the Commonwealth the years in which the greatest yields were obtained were as follows: New South Wales, 1852; Victoria, 1857; Queensland, 1900; South Australia, 1904. and Tasmania, 1899.

The Popularity of Linoleum in Norway.—The use of and demand for linoleum increases steadily from year to year. No inlaid linoleum is made in Norway. The one factory operating in Norway produces 1,540,000 lbs. (estimated) of printed linoleum annually, valued at £22,000. During 1912 (the latest available statistics) there were imported from the United Kingdom and Germany 2,554,454 lbs. of inlaid linoleum, valued at £50,000, none coming from other countries. The increasing demand for linoleum seems to be

the result of a spreading sentiment in favour of sanitary precautions. In the case of Christiania it is estimated that 80 per cent. of the population live in rented homes. Where there are hardwood floors linoleum is not used, but in much the greater part of rented buildings or apartments the tenants insist on either hardwood floors or floors covered with linoleum. As a result, the floors of the greater part of rented apartments are covered with linoleum by the landlords. Sometimes rugs are laid on the linoleum; in many and an increasing number of cases neither rugs nor carpets are used. The linoleum or hardwood floors are cleaned and waxed daily, Norwegian homes being proverbially neat and clean. The tendency is towards single colours without figures of any kind, or at least not very pronounced figures. Tints now preferred are neutral green, red, and brown.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock:—

January 20.—J. A. Hunter, "The Textile Industries of Great Britain and of Germany." Lord Rotherham, President of the Textile Institute, will preside.

January 27.—Hon. John Collier, R.O.I., "Portrait Painting." Lord Sanderson, G.C.B., K.C.M.G., will preside.

February 3.—Octavius Charles Beale, Chairman of the Australian Manufacturers' Association, "Imperial Industrial Development after the War."

February 10.—F. Vincent Brooks, "British Lithography in 1915."

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

January 21.—Henry John Elwes, F.R.S., "Nepal." The Right Hon. Sir Herbert Maxwell, Bt., F.R.S., will preside.

February 11.—Captain Sir George Duff Dunbar, Bt., I.A., "Tribes of the Brahmaputra Valley."

March 18.—Lieut.-Colonel A. C. Yate, I.A. (retired), "The Indian Army."

April 15.—M. M. S. Gubbay, I.C.S., "Indian Trade and the War."

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

January 26.—Major E. H. M. Leggett, R.E., D.S.O., Managing Director of the British East Africa Corporation, "The Economic Development of British East Africa and Uganda."

February 2.—Edward R. Davson, "Sugar and the War."

Dates to be hereafter announced:—

Thomas Worthington, "The Work of the Commercial Intelligence Branch of the Board of Trade."

T. Thorne Baker, "The Industrial Uses of Radium."

Frank Baines, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

E. W. Hulme, "Patent Law."

H. M. Thornton, "The Industrial Uses of Coal Gas."

D. Y. Cameron, A.R.A., R.E., "Etching."

Roger Fry, "Post Impressionism in Design."

C. H. Sherrill, "Ancient Stained Glass."

William Poel, "Shakespeare's Profession."

Arthur Wilcock, "Designing for Textiles."

Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

April 15, May 13.

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

March, 2, 30, May 4.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

Dr. F. Mollwo Perkin, F.I.C., F.C.S., "Oils, their Production and Manufacture." Three Lectures.

January 18, 25, February 1.

M. H. Baillie Scott, "House Building-Past and Present." Three Lectures.

March 15, 22, 29.

David Sommerville, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

Fothergill Lectures.

Monday evenings, at 8 o'clock:—

Professor Vivian B. Lewes, F.I.C., F.C.S., "Motor Fuel." Three Lectures.

February 15, 22, March 1.

Juvenile Lectures.

Wednesday afternoons, at 5 o'clock:—

H. Plunket Greene, "How to Sing a Song." Two lectures, with vocal illustrations.

January 6, 13.

Journal of the Royal Society of Arts.

No. 3,241. VOL. LXIII.

FRIDAY, JANUARY 1, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, JANUARY 6th, 5 p.m. (Juvenile Lecture.) H. PLUNKET GREENE, "How to Sing a Song."

The lectures will be accompanied with numerous vocal illustrations.

Special tickets are required for these lectures, and no person can be admitted without a ticket. A few tickets are still left, and these will be issued to Fellows who apply for them at once.

Further particulars of the Society's meetings will be found at the end of this number.

COVERS FOR JOURNALS.

For the convenience of Fellows wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1*s.* 6*d.* each, on application to the Secretary.

LIST OF FELLOWS.

The new edition of the List of Fellows of the Society is now ready, and can be obtained by Fellows on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

A meeting of the Indian Section was held on Thursday, December 17th, 1914; SIR STEUART COLVIN BAYLEY, G.C.S.I., C.I.E., in the chair.

The paper read was—

THE INDIAN INDIGO INDUSTRY.

By F. MOLLWO PERKIN, Ph.D., F.I.C., F.C.S.

About this time last year the late Mr. Popplewell Bloxam was to have read a paper on "Natural or Plant Indigo," and had already practically finished writing the paper when his untimely death occurred. From the slides which Mr. Bloxam had had prepared, it is evident that he had intended in the first place to describe the method of production of indigo, and I have also decided to give a brief description of the manufacture of the dye from the indigo plant, because, although some present will be familiar with the process, there are others who may not be. By the kind assistance of the Secretary of the Indian Section I have been permitted to make use of the slides prepared for Mr. Bloxam from photographs taken by Mr. H. Martin Leake.

Mr. Bloxam was a believer in the possible resuscitation of the Indian indigo industry, and he intended to urge on the planters more vigorous efforts in research, both chemical and agricultural. Since last December great changes have taken place owing to the terrible war into which the world has been plunged. In consequence of the cessation of the supplies of synthetic indigo, which is a German product obtained entirely from Germany, Indian indigo is at a premium, but unfortunately it is only possible to obtain it in comparatively small quantities, and this is causing great inconvenience to the dyers.

Indigo, being one of the fastest of blue dyes, and having peculiar properties of resistance to light and weather conditions, is used in very large quantities for dyeing the cloth used in making the clothing of our sailors and also for dyeing serges in general.

In 1895-96 the total value of plant indigo produced was £3,566,700, and the acreage under cultivation 1,339,099 acres. Last year, owing to the competition of synthetic indigo, the value had fallen to £60,000- £70,000, and the total acreage under cultivation had been reduced accordingly.

The cultivation of the indigo plant and the production of the blue indigo dye is one of the oldest industries. Certain blue cloths obtained from Egyptian mummies more than 5,000 years old were found to be dyed with indigo.

Pliny described it under the name of *Indicum*, and said that it was used as a paint and came from India. It was not, however, until the sixteenth century that indigo was introduced into Europe, and then its introduction was very slow owing to the opposition of the woad cultivators. As a matter of fact, the blue colouring matter obtained from woad is indigo. The opposition of the woad cultivators was purely due to their desire for self-preservation. They contended that the dye from Indian indigo was fugitive and was a dangerous and pernicious drug, and in fact were successful in obtaining legislation making its use punishable by heavy fines.

The plant from which indigo is obtained only flourishes in hot climates. Consequently it can only be cultivated in tropical countries. The largest quantity of indigo has always come from India, particularly from the Provinces of Bengal, Madras and Oudh. The plant is also grown in Java, and the indigo manufactured there has a very much higher percentage of the blue colouring matter, indigotin, than that produced in India. Small quantities are also cultivated in Central America, Japan, China, Brazil, and in some parts of Africa.

The indigo plant, in order to flourish satisfactorily, requires certain conditions. The season must not be too wet or too dry. If the season is wet immediately after the seed has been sown it mildews and is spoilt and re-sowing is necessary. In bad seasons the crop may require to be so re-sown several times. The seed is usually sown in February or March, but much rain during these months will necessitate postponing the sowing, and thus a late crop will be obtained. The ground upon which the indigo is to be cultivated is prepared at the end of the "mahai," or manufacturing season, which is towards the end of October and during November. Great care is taken to prepare the surface of the ground suitably. The weeds, etc., are first removed by means of hoeing, after which the land is ploughed by means of bullock-drawn ploughs, which first furrow lengthways and then across at right angles. A "hanga," that is, a heavy wooden pole, is then drawn across the broken-up ground. This serves the double effect of breaking the clods and of smoothing down the soil. The land may then be ploughed over again several times, each time being run over by the "hanga." By this means it is broken down to a very fine state and is then very often rolled over so that a good top surface is formed which prevents the rapid evaporation of the moisture. In February or March the seed is sown by means of drills.

There are several varieties of the indigo plant, the most important being *Indigofera tinctoria*, and *Indigofera anil*. These were until lately the chief varieties cultivated in India. *Indigofera arrecta*, which is the variety used in Java, has in recent years been satisfactorily introduced into India with improved yields of the dye. *Isatis tinctoria*, or woad plant, is the variety grown on the West Coast of Africa. It is also to a small extent grown in Lincolnshire and on the Continent. It is not, however, cultivated for the extraction of the dye, but is used in fermentation vats in dyeing woollen goods.

The indigo plant is herbaceous, and grows to a height of from three to four feet, having a single stem about half an inch in diameter. The plant belongs to the natural order Leguminosæ. Consequently it is able to obtain a portion of the nitrogen required for its nourishment from the air. This is a very important fact, because as a rule the soils in which indigo is cultivated contain only small quantities of nitrogen. It might, of course, be increased by manuring, but this has never been done to any great extent. The manure chiefly used is the air-dried refuse of the indigo plant which is left behind after the indigo has been extracted, and is called "seet."

Generally speaking, the indigo plant is ready for harvesting about the middle of June, but if the sowing has been early and the weather conditions have been satisfactory, it may be ready at the commencement of the month. On the other hand, bad weather conditions may have a retarding influence on the growth, when it will not be ready for cutting before the end of June. The process of cutting and manufacturing is, in the main, carried out under European directions, but native labour is employed, and the falling off in the production of indigo has caused considerable unemployment. The plant as it is cut is tied into bundles, placed on bullock-waggons, and immediately taken to the steeping vats. These vats are built of brickwork lined with concrete or cement. The bundles of plants are packed into vats in a more or less upright position to allow the air and gas bubbles produced by the subsequent fermentation to be readily liberated. When the vat has been packed bamboo canes are placed across the top of the green plant and held in position by stout balks of timber which are fixed to the sides by means of iron pins. Water is then run in to within five or six inches of the top of the bundles. As the steeping proceeds great expansion of the

plant takes place, and an immense pressure is exerted on the beams, which occasionally are fractured, or the sides of the vat sometimes give way under the pressure. After steeping for a few hours fermentation sets in. The fermentation is induced by an enzyme contained on the leaf of the plant, which is known by the name of "imdimulsin"—just as the grape skin contains the enzyme or ferment necessary to cause the fermentation of the sugar contained in it to alcohol. The rate of fermentation varies with the temperature of the water. Usually the temperature of the water in June and July is from 88° to 94° F. If the temperature is lower—as, for example, in September when the second crop is treated—a longer steeping is necessary. As the fermentation proceeds bubbles of gas—mostly carbon dioxide—are given off and the surface of the liquid presents a foamy appearance. Towards the end of the operation inflammable gases—hydrogen and marsh gas—are given off. At the end of ten to fifteen hours the vigour of the fermentation subsides, and this indicates to the practised overseer that the steeping should be stopped. The tap or valve into the beating vat is now opened, and the liquid run out as rapidly as possible. At this stage the liquor has a colour varying from a pale to a golden sherry yellow. The more golden the colour the greater the yield of indigo. It often happens, however, that the lighter coloured liquor, although giving a smaller yield of indigo, gives a purer product.

In the beating vat the liquor is agitated and splashed, so that it becomes mingled with the air. The beating is often done by natives, who stand in the vat armed with wooden paddles. It is now, however, more frequently carried out with paddle-wheels actuated by steam power. Soon after the beating has commenced the colour of the liquid becomes greenish, and finally deep blue, owing to a fine precipitate of indigo blue being formed. To ascertain when the beating has been carried out sufficiently a small portion of the liquid is poured on to a white plate. If the indigo sinks to the bottom rapidly leaving a clear supernatant fluid the operation is finished. If a strong current of air is forced through the liquid in the vat better results are obtained than by beating, and in some cases this is done.

After the beating is completed the indigo is allowed to settle, which generally requires from two to four hours. The bottom of the vat is inclined towards one end, so that the indigo as it is precipitated collects at this end. As soon as the separation is complete the water is run off from above the precipitated indigo. This water is called "seet water." The indigo precipitate, or "mal," as it is termed, is passed through strainers in order to hold back any twigs or leaves which may have found their way into the beater. It is then run into a well, and from there raised by pumps or steam-injectors through strainers into the boiling tank. The temperature here is raised to nearly boiling point, or sometimes the mixture is actually boiled, generally by means of steam. The boiling kills putrefying ferments, dissolves out some of the foreign matters, and causes the solid indigo particles to separate out more rapidly. Sometimes the supernatant liquid is drawn off, clean water added, and the temperature again raised. It would probably be a good thing if the second washing and boiling were always carried out. After the indigo has settled, the bulk of the water is run off and the indigo sludge is run on to the dripping vat. This consists of stout cloth fixed on a wooden frame with sides about one and a half feet high. The excess of water drains off here and a pasty mass is obtained, which contains from 9 to 11 per cent. of indigo blue.

From the filters the indigo pulp is run into the presses, which consist of rectangular boxes with perforated framework. The box is lined with closely-woven cloth made specially strong to withstand pressure. The paste is run in to a sufficient depth to produce—after the water has been pressed out—a cake about three inches thick. The cloth is then folded over and the top of the press very slowly moved down by means of a screw worked by strong levers. The pressure must be very carefully exerted, otherwise the cloths will break and the indigo pulp will be squirted out and wasted. When water ceases to flow out the pressure is slowly removed, and the pressed slab placed on a frame and cut in cubes with brass wire in a similar manner to that employed for cutting cheese. Each cube is roughly three inches square, and is stamped with the mark of the firm. The cubes still contain a considerable quantity of moisture, 68 to 70 per cent., and before being placed on the market they must be dried; indigo as received in Europe usually contains from 4 to 6 per cent. of moisture. In order to dry the cubes they are placed on shelves about half an inch apart, and left to dry for a period of two or three months. The sheds in which the cubes are placed allow of free access of air, but it does not do to have too free a circulation,

otherwise the outside portions dry too rapidly and the cakes fissure and break, and lose in market value. As the drying takes place the indigo becomes coated with a mouldy fungus, and at the same time ammonia is evolved. When thoroughly dry the cakes are brushed and then packed into strong cases and sent to the market.

After the indigo plant has been cut, fresh leaves sprout out, and at the end of two or three months a second crop of the plant is cut. The first crop, which is the principal one, is called the "Mohan," and the second crop the "Khoonties." It sometimes happens, if there has been much drought when the first crop was maturing, that the second crop gives a better yield of indigo than the first crop.

Indigo blue does not exist as such in the plant, but is there combined with a sugar—dextrose—in the form of a substance called a glucoside, the name of this sugar-bearing substance being "indican." This glucoside is, however, very unstable, and is readily split up into its compounds—sugar and indoxyl, which latter, on oxidation, yields indigo.

1. $C_{14}H_{17}NO_6 + H_2O = C_6H_{12}O_6 + C_8H_7NO$
Indican Water Glucose Indoxyl

2. $2C_8H_7NO + O_2 = C_{16}H_{10}N_2O_2 + H_2O$
Indoxyl Oxygen Indigotin Water

In the processes just described the breaking-down of the indican into indoxyl was produced by fermentation induced by the enzyme indimulsin. The oxidation of the indoxyl to indigo blue or indigotin is brought about by the beating process. Acids or alkalies also have the power of breaking up the indican and resolving it into glucose and indoxyl. As a matter of fact, the process does not work quite so smoothly as shown above. The indigo blue is never obtained pure, but is contaminated with greater or less quantities of brown and generally red-coloured substance, also with a gummy substance called indigo glutin.

From the foregoing description of plant indigo, it will be gathered that the method of manufacture of natural indigo is rather crude, one might safely say very crude. It is doubtful whether, even now, after the disastrous competition of the synthetic product, the methods employed are very much superior to those in use when the winding-sheets of the Egyptian mummies were dyed. One of the difficulties the planters have had to deal with has been the large number of cranks and charlatans who have come to them with schemes which only required to be tried or to be looked at by a capable chemist to show their worthlessness. The planters once bit were many times shy of displacing a method which they understood by one which might mean great financial loss However much we might realise their difficulties when the production and introduction of synthetic indigo on the market was *un fait accompli*, they knew as far back as 1880 that indigo had been synthesised, and they ought to have known how artificial alizarin, introduced in 1869, killed the madder industry in a few years. I say "ought to have known," because I very much doubt whether, outside indigo, they knew or cared about any other dye. As far as indigo was concerned they probably argued "the ancient mummies were dyed with indigo, and that was 5,000 years ago; we are to-day making great profits out of the same indigo. Is it likely that this product just invented can ever drive our indigo out of the market in our time?"

Now the question arises, Is it possible to save the Indian indigo industry? Probably a thousand years hence indigo blue will still be used, as we have discovered no other dye with similar properties; but will it be made synthetically or will plant indigo be used? I should like to think it will be the natural product; but look at the difficulties.

The amount of the blue colouring matter obtainable from the indigo leaves probably does not, as a rule, exceed 1 per cent. In the process of manufacture it is doubtful if more than 50 per cent. of the colouring matter is obtained—the rest is lost. The cake indigo, when placed on the market, varies enormously in purity. Good samples of Bengal indigo may analyse 62 to 66 per cent. of indigotin, whereas some indigos are as low as 30 per cent. Java indigo is often 70 per cent. and sometimes as high as 76. It is claimed that it is sometimes as high as 90 per cent., but I never yet came across a sample of such high purity. As a matter of fact, in spite of the much higher purity of Java indigo, the dyers, as a rule, prefer Bengal indigo. This is probably due to the much higher percentage of red indigo which is usually present in Java indigo. Contrast this with synthetic indigo, which can always be placed on the market with a guaranteed indigotin content. It can either be bought as a powder or in the form of a paste. Another great difficulty which the indigo planter has to deal with is due to meteorological conditions. Thousands and thousands of acres of land may have been planted with indigo seed, but

who will guarantee a good crop? There may be no rain, there may be too little sun, or there may be too much sun. If there were no synthetic indigo, probably the planter would not mind much—he would get a higher price for his product. But when he is confronted with a product which is manufactured from start to finish in a factory and which is absolutely unaffected by climatic conditions, he is in a similar position to a battleship outranged by the enemy's guns. One bad season which prevents him being able to supply the demand may be sufficient to lose him the bulk of his markets. The dyer may say—"I prefer the natural indigo; it dyes a deeper shade, or it penetrates the fibre better; but when I most want the dye I cannot be sure of obtaining it." With synthetic indigo it is not so. The factories are always able to increase their supplies to meet the demand.

The subject of my paper is natural and not synthetic indigo, and it is not my intention to describe the various methods of manufacturing the synthetic product. In any case I could not improve on the splendid paper read before the Royal Society of Arts in 1901 by Professor Meldola. At the same time, to ignore this magnificent chapter of research and chemical industry would be out of place, particularly as it is a factor the planter cannot ignore. While the indigo planter and indigo merchant slumbered, the busy brains of highly-trained chemists and engineers were following up first one path and then another in order to solve the problem of the manufacture of synthetic indigo on a commercial scale. It has often been stated that the object of the research chemist is to multiply new products, and that so long as a new substance is obtained he is satisfied. That attitude most certainly was at one time taken to a considerable extent by those who worked in university laboratories, particularly in this country. I doubt if it was ever the feeling of the chemist working on the Continent. At one time there was a tendency for the scientific worker in Great Britain to look down upon those who he said were simply doing research work with the object of making money. "Fancy," they said, "carrying out research work because its ultimate end may mean the amassing of wealth! We do our work for the love of science and for the advancement of science." This attitude had at one time a great deal to do with the position taken up by the manufacturer. He naturally considered that men who thought in this way would not be of any value in a factory, and would simply spend their time in the laboratory and not attend to the details of putting a process on a commercial basis. The British manufacturer is always blamed, and there are very few who will take up the cudgels on his behalf. In the chemical industry his sins are very great, but I maintain that the men of science in this country must also share in the blame. I suppose this is rank heresy, but as I believe that both the manufacturer and man of science have to turn over a new leaf and collaborate whole-heartedly and without jealousy, I think it only fair to state my belief.

There is nothing more exhilarating than gradually to develop a process. To commence with a few grains in a test-tube; to prepare a few ounces, then a few pounds, and from pounds to hundredweights and tons, so that finally a commercial process results—that is research in its highest form. Look how it benefits the community. It is said that he who can cause two blades of corn to grow where before there was only one is a benefactor to mankind; and in a similar manner he who, by laborious research work, is able to enrich his country by a new discovery and by a new manufacturing process, deserves well of that country. What was the attitude of the Indian indigo planters when indigo was first synthetised in the laboratory? They adopted a sceptical attitude; they knew how to manufacture indigo from the plant. It was not possible that a product produced in the leaves of a plant, fertilised by the rains from heaven and by the light of the sun, could be produced from tar distilled from the coal. They sat still. Their money came in regularly until in 1898, as one planter stated, they were startled by a bolt from the blue.

It was in 1880 that Baeyer first completely synthetised indigo, employing toluene as the starting product from which, by a series of steps, phenylacetic acid was prepared, and by another series of reactions ultimately isatin and then indigo were obtained. In the same year he discovered the cinnamic acid method, the starting point for which was again toluene. Before 1875 cinnamic acid was obtainable only in small quantities from natural products such as balsam of tolu, and was a rare product. In that year, however, a process was discovered in this country whereby it could be produced by heating benzaldehyde with acetic acid and sodium acetate. The starting product for benzaldehyde is toluene. The first patent for indigo was taken out in March, 1880. This fact seems to have caused considerable uneasiness amongst the Indian planters. This process and

many succeeding processes were, however, too expensive for the synthetic indigo produced to compete with the natural product. Consequently the planters, with crass ignorance of the previous feats of chemical research, took no further heed, went on as before, and made no efforts to improve the antiquated process for producing plant indigo.

In 1879 my father gave a series of lectures on the history of alizarin, and said, in his concluding remarks: "One very important colouring matter related to coal-tar, and one of the original sources of aniline—a product of as great importance as alizarin—has yet to be produced on a large scale. I refer to indigo. Baeyer has shown that it can be produced artificially, but at present no practical means of accomplishing it have been discovered. No doubt, however, it will not be many years before this is achieved, and the cultivation of the indigo plant share the fate of madder."

That was probably the first of the warnings, but many other warnings were sounded in subsequent years as process after process was developed and patent after patent taken out.

In 1898 synthetic indigo was placed on the market at a price which enabled it to compete with the natural product. Then, indeed, the planters did waken up. There were cries for help, and fevered efforts were made to improve the methods of manufacture. Like most fevered efforts, they were unfortunately spasmodic. Nearly twenty years had been employed in developing the synthetic process, and nearly £1,000,000 sterling had been spent before a pound was placed on the market. If, during that time, patient research had been carried out in India there is very little doubt that the process would have been improved and larger yields of indigo obtained per acre of land cultivated. The Dutch have had greater foresight than the Indian planters. Indigo from Java has a much higher indigotin content than Bengal indigo, and is more uniform in quality. The reasons are that:—

(*a*) The land is better irrigated.

(*b*) Different method of planting. The seed is sown in protected areas, and when the plant is about six weeks old, and able to stand changeable weather conditions, it is planted out. It has already been mentioned that much rain or much drought directly after sowing in India necessitates re-sowing.

(*c*) Soft water is used in fermentation.

(*d*) The areas planted are smaller than those in India, and are consequently more easy of control.

Although Java indigo contains a higher percentage of the blue colouring matter indigotin than Indian indigo, it is not generally liked so much by the dyers as a good Bengal indigo.

It is often stated that synthetic indigo is not the same body as natural indigo. So far as the blue *indigotin* is concerned there is absolutely no difference. Indigotin, whether obtained synthetically or by extraction from natural indigo, is identically the same body. Synthetic indigo is practically pure indigotin. Natural indigo is a mixture of indigotin, indigo red, indigo brown, and a glutinous substance. Sometimes there are small quantities of indigo yellow. Besides these organic substances there is also mineral matter, sometimes in very considerable quantities. It is claimed that the presence of the other organic substances mixed with the indigotin is an advantage, and that not only does the indigo penetrate the goods better, but that the vat will go a longer way than when a synthetic indigo is employed. It is also claimed to be faster to light. It is certain that many dyers prefer it, but I have not, as a rule, found any tendency for them to agree to take only natural indigo when they can obtain the synthetic product equally well. The synthetic indigo is easy to manipulate. It comes on the market in the form of a fine powder or in a paste of guaranteed percentage of indigotin. Personally, I have not always found it come up to the guarantee.

The Germans were not content with manufacturing synthetic indigo. They also experimented with the best means of reducing it and preparing a good working vat. Indigo itself does not dye, because it is insoluble in water. If, however, it is reduced, the blue colour vanishes and a pale yellow solution containing indigo white is obtained. On exposure to air, oxygen is absorbed and indigo blue again obtained. If wool is steeped or passed through this vat and exposed to the air, the indigo white is oxidised *in situ* and the wool becomes dyed blue. The Germans, therefore, carried out research in order to find the best vats which could be used with synthetic indigo. Having found them they not only supplied the indigo, but also sent their chemists round to the dyers to show them how to make and use these vats. Could anyone imagine a planter devising a vat, or sending round to show how the vat should be used? I have not come here to anathematise the planters or anyone connected with the manufacture and use of natural indigo; but it is necessary to point out why the Germans have obtained their ascendancy.

To my mind it is a very sorrowful fact that no British chemists have had anything to do with the elucidation of the synthetic indigo problem.

Now the question arises—and it is one of the greatest interest to those who are present—Is it possible to save the Indian indigo industry? At present we are at war with Germany, the producer of synthetic indigo. How long that war will last it is impossible to say, but, in the meantime, dyers are crying out for indigo. The present quantities of natural indigo are wholly inadequate to satisfy the demand. Are the planters prepared largely to increase the acreage under cultivation? If one goes to the capitalist in this country and says: "We require aniline dyes and, if we had the money, could manufacture them," the reply is that Germany has for years held the monopoly. If we start manufacturing now during the war there will be no difficulty in selling the dyes; but what about after the war? I understand that is also the attitude of the Indian planter. "If I cultivate more land for indigo, increase the size of my factory, and sell at good prices during the war, what about after the war? Will the Government and will British dyers guarantee to take the natural product when they are offered the synthetic?"

An appeal has been made to the Government to use only Indian indigo for the dyeing of all Government contracts. In this appeal it is stated that fifteen years ago the value of Indian indigo was between £3,000,000 and £4,000,000; and in 1914 the value was between £60,000 and £70,000. Although I am in complete accord with the objects of this petition, and hope most sincerely that the Government will see their way to employ the natural product for dyeing the uniforms of Government servants in the Army, Navy, Post Office, the Police, etc., I must, as a chemist, take exception to the expression "German chemical substitute." Synthetic indigo is not a substitute; it is precisely the same indigotin as that obtained in natural indigo. Nor am I prepared to agree that synthetic indigo is poisonous. I think it is a great pity that these two irrelevant statements have been made. They weaken and do not strengthen the case.

Personally, I believe that for many classes of material better results are obtained with natural indigo than with synthetic indigo.

One very important consideration in reference to the production of natural indigo is an economic one. In many cases the land which was previously cultivated for indigo has been planted with the sugar-cane or with oil-seed plants. Now which pays the planter the better—to cultivate sugar and oil-seed plants or to cultivate indigo? If the indigo gives the smaller return on his capital, he certainly will not go back to cultivating it simply from patriotic reasons. I am also afraid that the dyer will not go back to using it in place of the synthetic product if the latter is easier of manipulation and the supply more certain.

Undoubtedly it will pay the planter for the next two years to increase the output. There cannot, however, be any increased quantity on the market before this time next year. The ground has to be prepared; in fact, should have been prepared now. Has a larger acreage been prepared, so that the seed can be sown in February or March? I am told that the weather, before the tilling of the soil took place this year, had been too dry. That will militate against a good crop.

Owing to the recent curtailment in the area of ground cultivated, it is doubtful whether there is sufficient seed obtainable to raise a very much larger crop for next year's manufacture. What, then, is to be done? Indigo is wanted and wanted in large quantities, and at once. As just mentioned, no fresh supplies other than those just coming on to the market can be obtained until this time next year, and it does not appear that next year's supplies will be sufficient to meet the demand. The work of Bloxam and his colleagues points to the possibility that better yields of indigo could be obtained by improving the methods of fermentation. When the indigo plant is steeped, fermentation takes place and the glucoside is split up into glucose and indoxyl, which the subsequent beating converts into *indigotin*. Unfortunately, however, degradation products of indigotin, such as indigo-brown, are produced at the same time, thus reducing the yield of the blue colouring matter. Whether they are produced by the further action of the enzyme indimulsin or by other ferments, which is very probable, is not yet known. A more thorough study of the fermentation process on the spot might, however, elucidate this. If the indigo planter is to put the production of natural indigo on a firm foundation, it will not be merely a question of making money while the war is on and prices are high; it will be a question of improving the methods so as to get higher yields of indigo and thus reducing the price. It is also important that the improved conditions should, as far as

possible, give an indigo of standard quality. To fix a standard is admittedly difficult. It does not follow that an indigo of high indigotin content necessarily gives the best results when used by the dyer. An indigo analysing, for example, 62 per cent. indigotin, may give equally good results in the vat as one analysing 67 per cent. This may be due to some particular impurity in the indigo of higher indigotin content, or to the presence of some material in the one of lower analysis which aids its penetrative action into the fibre. These, of course, are matters for research. They certainly do seem to point to some differences in the vats made from natural and synthetic indigo.

The method of analysis at present used is a modification of Rawson's process. It requires great care and considerable practice to obtain concordant results. There is also the tetra-sulphonate method of Bloxam which, when properly carried out, gives the absolute indigotin (that is, the indigo blue) content. The Rawson method always gives higher results than those which are obtained from that of Bloxam. The reason is that not only indigotin is oxidised by the permanganate, but also small quantities of other organic bodies such as indigo glutin. Indigo is, however, analysed by the Rawson method in India and the analysis sent forward with the overland samples. The indigo is sold on the analysis, and should any great discrepancy be found between the analysis in India and that here it is awkward for the broker. Another point, of course, is that natural indigo is not pure indigotin but a mixture of indigotin, indigorubin, indigo brown and indigo glutin. The Bloxam method has also shown that synthetic indigos are very frequently below standard in their indigotin content. Generally speaking, I employ the modified Rawson method, but as a check between two indigos for actual indigotin content I employ the Bloxam tetra-sulphonate method.

Other important points which may even at this late hour help to prolong the life of the industry may be summarised as follows :—

(*a*) Selection of seed and the propagation of the qualities which yield the highest percentage of indigotin. In this connection it must be remembered that one seed is best suited to one district and another to another district, owing to differences in the soil and climatic conditions.

(*b*) Chemical improvements in the manufacture. These must not be carried out haphazard, and if results are not immediately shown the planters must not get impatient, and after a short trial say, "What good are you doing?" and get rid of their chemist. Remember the eighteen years and the huge sums of money spent, and the patient work of the German chemists, before they were able to produce synthetic indigo.

(*c*) Economy in management.

(*d*) Agricultural experiments with different fertilisers and the rotation of crops.

The wonderful development of the beet-sugar industry was very largely due to improvements in agricultural methods. When the industry was first started the amount of sugar in the root was not more than 6 or 7 per cent. By improvements in fertilisation and selection of the best plants the yield is now more than 14 per cent.

A large amount of most valuable research work on indigo has been carried out at the University of Leeds by the late Mr. Bloxam and his colleagues, and if some of the most important conclusions arrived at are tested in India on a commercial scale good results should accrue.

In conclusion, I feel constrained to say that in my opinion the Government should insert a clause in all their contracts where indigo blue is to be employed for dyeing that only natural indigo should be employed. If after a few years' trial it is found that the indigo planter is unable to meet the demand, and if it can be proved that better results can be obtained with synthetic indigo, then the natural indigo industry —like the natural alizarin obtained from the madder plant—must cease to exist.

My advice now is—let the indigo planter take his courage in both hands and prepare and sow largely increased tracts of land. This, at any rate, will relieve the shortage; it will also show the Government that Indian indigo is obtainable in sufficient quantities to meet the demand. Concurrently with the production of larger quantities of indigo let him put part of the profits to a research reserve. Then perhaps the Indian or Home Government will also aid with pecuniary help. Unless the manufacturers of natural indigo are prepared to work on scientific lines in all round improvements of the methods —agricultural and chemical—I see no possibility of increasing or even retaining the industry.

DISCUSSION.

THE CHAIRMAN (Sir Steuart Colvin Bayley), in opening the discussion, said it was nearly fifteen years ago since he was present in the room when a paper on the subject of indigo was given by Mr. Rawson. The chair was occupied on that occasion by one who had recently passed

away, and who had been an intimate friend of his own. That gentleman had been the best leader the planters had ever had, whether in the field or in the council room, whether as presiding over the Planters' Association or as colonel of the Bihar Light Horse. In his own district he had been a man of extraordinary influence, which he always exercised wisely and well. He referred to Sir William Hudson. At that time—some fifteen years ago—the situation was in some respects similar to what it was at present, and in other respects very dissimilar. The planters suddenly began to realise what the production of synthetic indigo and its being brought on the market meant to them. The battle between the chemistry of Nature, backed by rule of thumb, and the chemistry of science, backed by scientific methods of manufacture, had commenced; and already it was very obvious to which side the victory would incline. The planters called for help. The Government gave them what little help they thought proper and expedient. The planters called for help from chemists, and they got good chemical advice. But with what result? Of the measures taken, some were insufficient and the others were too late. That was all that was to be said then. The following year there was a paper given, not specifically upon indigo, but upon the chemistry of aniline dyes generally by Professor Meldola. In that paper, although it was almost entirely technical, Professor Meldola went at some length into the methods by which synthetic indigo had been arrived at, and he showed not only the extraordinary ability but the marvellous patience, tenacity, co-ordination, and co-operation between capital and science which, after eighteen years' work without any financial result, and after the expenditure of nearly a million pounds, succeeded in bringing synthetic indigo on the market, and Professor Meldola asked very naturally how a thing of that kind could be worked in England. Again, only a fortnight ago a paper had been given before the Society by Dr. Ormandy upon the same subject — the question of the possibility of capturing the trade in aniline dyes, now that the German factories were practically closed. That paper was really intended to mean, no doubt, "Wake up, England!" But it was a real denunciation in no mild terms of everybody: a denunciation of the Government, a denunciation of Government officials, a vigorous denunciation of capitalists and of their outlook upon science, a denunciation of merchants and of banks; and the general result to his (the Chairman's) mind was one of extreme depression. The result would be not "Wake up, England!" but "Haul down your flag; it's no use." He referred to those papers to show that in all three cases the fault pointed out was the want of co-operation between science and capital. He was very glad to hear Dr. Perkin say a few words in justification of the merchants and manufacturers. He also thought a few words should be said on behalf of the poor planter. He recollected discussing with Sir William Hudson that very question forty years ago. At that time there was no danger, as far as was known, from synthetic indigo; but there was a danger of aniline substitutes bringing down the price of indigo, and he asked Sir William whether it was not possible for the planters, as a body, to employ a staff of agricultural chemists. Sir William consulted two or three planters, and the result was that the idea was negatived, not merely from apathy, but from real reasons. One was that the whole industry of indigo planting was not a co-operative industry, but strictly individual, and each man worked for himself on his own lines. Another point was that the planters were not always owners of the factories, and it was not always possible for them to combine in any matter in the absence of the real owner. As he had said, there was a certain similarity in the situation then as there was now. Planters were again asking for Government help and for the advice of sound agricultural chemists, but there was this difference. At that time the export of indigo was between £3,000,000 and £4,000,000, and at present it was between £60,000 and £70,000. Again, formerly there were 700 Europeans employed in the industry. Altogether the circumstances had changed. The question now arose, Was it worth while to try to recapture the trade? Dr. Perkin had given very sound advice on that point, but the first point to consider was how the planter could afford to set about it? To begin with, what were the present conditions of the structures—of the steeping vats, and the beating vats, and the drying houses? How much would it cost to put them into proper order? What had become of the planters' main stand-by, the Zeraats—the home-farms, as it were—which were always carefully manured? Were they in his own hands and at his own disposal, or were they let on long leases? To his mind the question was not one which could be settled either by the Government giving subsidies, or by the planters themselves. Did not it depend very much upon the dyers and upon the dyers' customers? and unless they were satisfied after full examination of the superiority of one class of indigo or the other, the contest would not be satisfactorily settled. There was another point. The planters, however well they might fare for the present, would have to be content at the end of two or three years with a new condition of affairs. As long as German factories were closed, well and good; but when they opened again at the end of two or three years, they would have on their hands an accumulation of stock, and was it likely they would hesitate to sell that at any loss in order to kill the renascent industry of natural indigo? Then there was another difficulty. He learnt that an important movement was on foot for securing for England the general aniline industry, including, of course, indigo, which was now in the hands of Germany, and it

was possible that the Government might assist. In that case the poor planter would not only have to contend with his foreign enemy, but he would find enemies among his own people in his own household. It would be a three-cornered duel, and the result was not easy to discern. So that altogether he could not say that the prospect three years hence was one which justified any very hopeful expectation; but he quite agreed that for the next two or three years any increase that could be put into the market of natural indigo would be certainly a paying proposition, and he only hoped that it might, as Dr. Perkin suggested, be the prelude to a bigger and better scientific agricultural system all round. In conclusion, he would be glad to hear any of the audience upon two points: one was the movement for capturing the aniline dye trade generally, and the other the consideration from the dyer's point of view as to the value in lasting effects of the two classes of indigo.

Mr. Donald N. Reid mentioned a method by which he obtained very much larger results from his lands than other planters. Instead of keeping his lands bare fallow, he used to grow indigo after the poppy crop was gathered, and within three months afterwards the indigo was manufactured. He also used the hot-water process and obtained good results. He noticed that those processes had been given up after he left the country.

Mr. T. Croysdale said he regarded the paper as somewhat of a funeral oration with regard to the cultivation of natural indigo. The suggestion was that owing to the present absence of synthetic indigo the cultivation of natural indigo might be resumed. He did not think, by the time that natural indigo came to this market, that it would obtain the present price, because it was most likely that by then synthetic indigo would again be flooding the market. Before the war began the price of natural indigo in Mincing Lane was about 2*s.* 6*d.* per lb. To-day it was 10*s.* per lb. He would be sorry for any planter who increased his cultivation in the hope of getting the latter price, as, before he could get his produce on to the market, synthetic indigo would again be in competition. With regard to the manufacture of synthetic indigo in the home market, the same thing applied very largely. It might be that synthetic indigo could be made in this country, but it would be very difficult for the Government to induce the public to subscribe three millions of money for the manufacture of synthetic indigo unless the public had some guarantee that they would be protected. If no protection was given, the first business of the German manufacturers after the war would be to undersell us and ruin the trade in this country. He believed that in the negotiations between the chemists and the Board of Trade the Government had made some sort of tentative offer for protection, but protection for a few years only was of no use. If the Government would guarantee protection for all time, then the British public would be able to subscribe money, and this country would not only be able to manufacture synthetic indigo, but the various aniline and alizarin dyes which were so largely consumed here.

Mr. S. G. Parsons stated that he had been selling indigo all his life, and he knew the planters and the buyers and the consumers. He did not consider the position of the planter was anything like so hopeless as Mr. Croysdale had tried to make out. No planter in his senses would ever expect to get the famine prices which at present obtained, but a planter could make a very handsome profit at prices of 3*s.* 6*d.* and 4*s.* per lb., and he (the speaker) did think planters would obtain reasonable prices for their indigo for some time to come. Again, if a duty was put on synthetic indigo coming from Germany, that would help the planter, because even if synthetic indigo was manufactured in this country it could never be sold at the same low prices that Germany sold it at, and if the price of synthetic indigo made in this country was, as he thought it very likely would be, 1*s.* per lb., instead of 6½*d.* charged by the Germans, that would give the planter a very much better basis on which to work. He thought planters could compete with synthetic indigo at 1*s.* per lb. and make a profit on their produce, but they could not compete with synthetic indigo at 6½*d.* per lb. Altogether, he did not agree that the outlook was so bad. One most valuable suggestion made by the author was that the planters, having now before them an exceptionally prosperous year, should put some of their profits towards a fund to improve their processes of manufacture, and to co-operate together for the benefit of the industry. Hitherto, the great fault of the planters had been that they had failed to co-operate.

Sir William Duke, K.C.I.E., C.S.I., in moving a hearty vote of thanks to the reader for his interesting paper, said there was a very wide divergence of opinion as to the future prospects of the Indian indigo industry. He thought, however, there was every prospect, for a year or two, that the planter would get a very good return from whatever he could produce from his present plant, and the land which he had at his immediate disposal. It must be borne in mind that if a planter was asked to go to further capital expenditure, to take up more land and put down more plant, he must have some definite prospects for some time to come, not merely for a year or two, but say nine or ten years. Dr. Perkin had emphasised the fact that much might be done in trying to improve the processes of manufacture with a view to getting a better indigo product. That was where perhaps least had yet been done. Something also should be done to obtain a better agricultural outturn. More had been done there, because that was a part

of the subject in which Government had particularly assisted. But when all was obtained that could be got by agricultural improvement, and when from the agricultural outturn everything humanly possible had been done in the way of an improved chemical output, he took it that we should still be working within very strictly defined limits—he meant that the agricultural outturn could not possibly be increased beyond a certain percentage, while the possible increase of the chemical output from that agricultural outturn must be similarly limited. The question was whether, with such improvements as could be obtained, the natural product would be able to compete with the synthetic product, supposing that the conditions which had prevailed up to the time of the war would be restored after the war. Possibly the planter could be satisfied that his outturn could be so improved that he could compete with the synthetic product as it was immediately before the war, but the question was, Was the synthetic product being sold at the lowest possible limit before the war? Was it not possible that the process of manufacture would be cheapened, and that, even supposing the planter grew two lbs. now where he grew one lb. before, the synthetic indigo manufacturer would still outsell him? In other words, was it not possible that whereas before the war Germany sold at a price of 6½*d.* per lb. she would after the war sell at 3*d.* per lb.? In that case, what would the chances be for the grower of natural indigo?

SIR EVAN JAMES, K.C.I.E., C.S.I., in seconding the vote of thanks, thought the Society was to be congratulated on having brought before an Anglo-Indian audience a paper giving such valuable and interesting information on a subject which was really of pressing importance. He hoped that synthetic indigo would be manufactured in this country, but he doubted whether the Government would protect it against foreign competition after the end of the war. Meanwhile, he hoped the planters in Bengal would try and make all the hay they could while the sun was shining.

The vote of thanks was carried unanimously, and the meeting terminated.

MR. A. WYNTER ROBERTS writes: The few surviving East India indigo planters who have had the temerity to persevere, under cruel conditions, in cultivating this beautiful and permanent dye—of which there are examples on fabrics woven thousands of years ago—are for once to be rewarded for their labours; not to anything approaching the full extent they would have been under free trade (the Government having prohibited the export from this country and from India except to this country, thus closing the door to keen competition from other countries), but it is to be hoped at least sufficiently to compensate them for losses sustained during a series of lean years. I recall meeting the late Mr. Henry Hudson entering the docks, probably for the last time, to look at the samples of several parcels of his mark, and the determination with which he said, "We (the planters) mean to go on." It is to be hoped that others will be equally resolute. Those who have spent the greater part of their lives in India cultivating indigo, and others in this country who have dealt with its distribution, still take a sentimental, as well as commercial, interest in what was a great industry. The decline, or practical ruin, was of course primarily due to the introduction of synthetic. Chemists say the latter is indigo. Should they not rather say synthetic indigotin, or anæmic indigo? If equal to natural indigo, why do some of our dyers, who produce the best work, adhere to the latter, and the Eastern races, whose carpets and fabrics last for generations, use natural indigo only, and why, if the two are identical, do dyers use natural in combination with synthetic? Good judges among the dyers differentiate between strong and weak indigo, yet the latter more than frequently yields the higher test. The system of buying and selling on test is modern, and its introduction led not only to injury to planters, but to misrepresentation, bribery and fraud, and, it has even been suggested, paved the way to make a market for synthetic. Analysis seems merely to have determined the percentage of indigotin. A vat made from Lower Bengal indigo, say a good J. & R. W. (Watsons' estates and factories producing this mark have long ceased to exist), testing 58 per cent. or 60 per cent., would last out a fine Tirhoot indigo testing 72 per cent. And a fine Java—almost pure indigotin—would be thrown away in a vat. But synthetic is stated to be equal to natural for piece dyeing, and has, of course, come to stay as a most important dyestuff. It is therefore misleading to talk of resuscitating the natural indigo industry if that is intended to imply anything like its former proportions. But so long as vegetable indigo can be supplied, even at considerably above the price to which it was driven by the introduction of synthetic on its merits, and by discreditable methods which have to some extent been exposed, it is highly improbable that the demand for indigo will die out. On the contrary, there were evidences of some increase in consumption, and values had actually advanced about 20 per cent. on the prices obtained by planters for last season's crop before the outbreak of, and consequently quite independently of, the war. The prevailing idea, except among those who are in actual touch with the trade, appears to be that indigo is dependent upon being able to compete in price with synthetic. If it were so, indigo could not stand. But if the production of indigo ceased, consumers of synthetic would receive a rude awakening—that is, if the latter trade were in German hands. Indigo has to some extent been driven out of production by undue depreciation in values, by some planters having to work with money borrowed at high interest, by

their produce being mercilessly sold in Calcutta at prices which would cover the advances, and by the system of buying arising out of "the combines," amounting practically to a "knock-out." Consumption would not have fallen off to the extent it has had qualities required for some markets been obtainable, for which buyers would willingly have paid extreme prices. Of late years I have been through many "Indigo shows," that is, samples of all the chests to be submitted for public sale, and have seen hardly a parcel suitable for Russia, very few for the Turkish markets, and sometimes not a single chest for Greece. This tends to show that buyers knew their business better than we or chemists could teach them, and that the various colours other than indigotin, and mineral matters, form the backbone and superiority of natural indigo. If it were not so the German chemists would not have expended fruitless efforts to fathom the mystery. Chemists attach possibly too much importance to purity and uniformity (synthetic for the trade is reduced from nearly pure indigotin to 20 per cent. paste). Before the days of the combines, all the private firms of dyers were in competition, and the making and maintaining of a vat was an art. To-day, active competition having ceased, the desideratum seems to be to reduce the process of dyeing so that "a child can do it." This may suit the proprietors (shareholders in the combines), who must be thankful if they get a dividend at all, but as many of the businesses absorbed by the combines yielded fortunes while in private hands, it should be an incentive to manufacturers and private dyers to take up the work in earnest. The policeman was said to be the best-dressed man in the City, and it is regrettable that the clause stipulating that natural indigo only should be used in dyeing the uniforms has been recently deleted from the contract. As the uniforms did not appear to have deteriorated, I asked one man, standing out in drenching rain, if his were a this year's cape? "This," he said; "why I have had it for five years!" I was advised by a clothing contractor, "while synthetic could be grown (!) at the present price, not to waste any time over natural indigo." Sailors in the Navy used to make their own clothes and paid a long price for the cloth, but all the alternate saturation with sea-water and drying in the sun made no impression on the colour. I believe that naval officers' uniforms and great-coats are still dyed with natural indigo, the result being that the clothing not only retains its natural colour but the staple is richer and fuller. The senior partner of a great firm of manufacturers in Lancashire, who used to buy five thousand pounds worth of indigo or more at a time, told me, after having practically given up using it, that he was positively ashamed of some of the goods that went out of his works, but the demand was all for cheapness. Much time and money have been spent, ostensibly on improving the quality and increasing the quantity of indigo obtained from the plant, but it appears that the latter can only be effected at the expense of the former. With the exception of Schrottkhi's first process (whatever it was), I have never seen anything approaching, much less improving upon, the qualities of the outturns of many years ago when the crops were at their largest, whilst the produce of some factories, previously of high repute, has been simply ruined by experimenting. The suggestion that at the end of the war the German company might have large stocks, and in order to compete against works established in the United Kingdom might reduce their price of 20 per cent. paste from about 6½*d*., at which it stood at the outbreak of the war, to 3*d*. per lb. is improbable. It is doubtful if there will be accumulated stocks, as, owing to the call to arms, there cannot be the supply of labour to carry on manufacture; also the large quantities of raw material formerly taken from this country are not available. Great Britain has only taken a small portion of their output; and, with the exception of Austria and our Colonies, their exports may be as usual, if they can continue to produce. It is not generally known at what price synthetic can be sold profitably. A German merchant in London, doing a large export trade in natural indigo, being a considerable shareholder in the German company, tried to ascertain, but was told to take his dividends and ask no questions. It is said to have cost a million to introduce, and may be carried on at the expense of other departments. The proposed company to be formed in this country under the auspices of the Government, for the manufacture of aniline and synthetic dyes, is taking definite shape. One of the difficulties which has hitherto stood in the way of developing this industry has been the duty on alcohol. By its exemption it is to be hoped our manufacturers will be able to produce the colours on as good terms as the Germans have in the past, not only for our home trade and Colonies, but for our friends abroad. While rendering such valuable aid to the synthetic and aniline industry by financial support and favourable conditions, it would be a great boon to the indigo planters, and benefit many of our fellow-subjects in India, if the Government would also assist the natural indigo industry. Financial help to planters requiring it during the growing and manufacturing seasons would no doubt lead to increased cultivation; but if there were a clause in all Government contracts stipulating that only natural indigo of British origin should be the blue dye used for all their departments, it would give the planters heart, and certainly lead to an increase of consumption for private, or rather public purposes, without injuring the enormous trade which must come in artificial dyes. Let us have "All British" certainly for Government work, but ungrudgingly including and encouraging Central American indigo for general purposes, as that product, known in the trade as "Guatemala," was a good second to "East India" in the old days, and still comes to this market

on a small scale, much of it of desirable qualities, and never disturbed by new processes. In the interests of planters there is room for a complete revision of the system of disposing of their crops in London.

MR. WILFRID MATHIESON writes: It seems to me that, in order to give the Indian indigo industry encouragement, an Act of Parliament might be passed during the war, as soon as possible, which would make the use of the word "indigo" illegal as describing any substance except the product of the indigo plant, or the use of the word in connection with any material, fabric or other thing except it be dyed with natural indigo. It is illegal to sell margarine as butter, and it should be illegal to sell the product of the laboratory by a name which should be strictly reserved to the natural product. It ought not to be difficult for the "kultured" German to invent a name for what is called synthetic indigo, as dissimilar to indigo as margarine, as a word, is different from butter, or Dutch metal from gold.

CANTOR LECTURES.

THE HISTORY AND PRACTICE OF THE ART OF PRINTING.

By R. A. PEDDIE,
Librarian, St. Bride Foundation Typographical Library.

Lecture II.—Delivered November 30th, 1914.

THE EARLY NINETEENTH CENTURY.

It is curious to reflect that in the year 1800, at least 350 years after the invention of printing, the art had developed so little mechanically that a fifteenth-century printer would have found himself quite at home in a printing office of the last year of the eighteenth century. He would have found the same wooden press, with perhaps some slight additions of metal screws and levers, which would be quite clear to his mind after one trial. He would see the same kind of inking balls used, and he would note that the paper, although of a quality not up to his standard for book printing, was produced in the same manner as in his own day. The type would perhaps appear to him better finished than that he recollected. But in all essentials the printing office of 1800 was the printing office of 300 years before. Everything we know to-day in the art has come into use since 1800.

The printed sheet of to-day is printed on machine-made paper. It is either set by a machine or set with machine-made type. It is either printed from this type or stereotyped by machinery. The press is a power press, and the resulting printed sheets are sewn, glued, and bound by machinery. My task now is to trace the development of the machine industry of to-day from the handicraft of the earlier period.

The three great inventions which made the present machine production possible were the paper-making machine, invented by the Brothers Fourdrinier in 1803; the printing machine, invented by Koenig in 1811; and photography, invented by Daguerre and Fox Talbot in 1839.*

Previous to these, however, an improvement which amounted to an invention had been made in the press by Charles, 3rd Earl Stanhope. The great change he introduced was to substitute iron for wood in the frame of the press, and add multiplying levers between the bar and the platen so that the work of the pressman was much reduced. William Morris was wont to say that this substitution of iron for wood was the only improvement that had been made in the art, and when we consider the enormous gain in rigidity we can understand what Morris meant. The power press did not exist for him, but he wanted the best possible effect from the hand press. The story of the hand press and its development after this date is an engineering one. Better castings, finer fitting, still more rigidity, and the proving press used to-day by photo-engravers produces those really wonderful proofs which their customers vainly try to emulate.

PAPER.

The paper-making machine invented in 1803 was in most of its essentials the paper-making machine of to-day. Up to this date all paper was made in single sheets by hand. The pulp was put into the mould by the workmen, and then the mould was shaken to distribute the pulp evenly, and the resulting sheet removed for drying and pressing. The principle of the invention was to substitute endless woven wire sheets for the mould, and as the paper was formed by the felting of the fibres to lead it between heated cylinders to dry and press it. As it came from the machine the paper was cut into sheets of the standard sizes. The continuous web of paper was being made in 1803, but it was not to be used as a web for rotary printing until 1868.

PRINTING MACHINERY.

The next great invention which attracts the notice of the student is the development of the printing press into a machine.

* The last date must be read in conjunction with the remarks on the history of photo-engraving in Lecture III.

The three principles of printing machinery are, first, the platen action in which the pressure is applied by one flat surface acting on another. This was the hand-press method. Then follows the cylinder, round which the paper is led, rolling over the flat bed on which the type is placed. The third principle is the rotary method, where both type and paper are placed on cylinders geared together. Of the two latter the third was the the first to be invented, but the last to be used. William Nicholson, in 1790, took out a patent for a rotary printing machine which, however, was never made for use. He also specified a flat bed cylinder machine similar in action as regards position of type and paper to the later invention of Koenig. But no really practical methods of using them were added to either of these inventions.

Before we come to the cylinder machines we must deal with the attempts to apply power to the hand press. Frederick Koenig in 1803, at Suhl, attempted this. He substituted leather rollers for the inking balls, and introduced mechanism to take the carriage under the inking rollers and then under the platen. Koenig came to London and succeeded in inducing Bensley, Woodfall and Taylor to finance him in his experiments. By 1810 he took out a patent, and in April 1811 he printed sig. H of the "Annual Register." This was a modification of Koenig's first attempt to apply power to the old form of press, and was patented by him in England in 1810.

The next year, 1811, he took out another patent, this time for the machine which was to be the parent of all flat bed cylinder machines from that day.

John Walter, of the *Times*, ordered two machines after seeing the new cylinder machine, and presumably after hearing Koenig's ideas for the future. The issue of the *Times* for November 29th, 1814, was printed entirely by steam power. Mr. John Walter's own account of the innovation is interesting:—

"Our journal of this day presents to the public the practical results of the greatest improvement connected with printing since the discovery of the art itself.

"The reader of this paragraph now holds in his hands one of the many thousand impressions of the *Times* newspaper which were taken off last night by a mechanical apparatus. A system of machinery, almost organic, has been devised and arranged, which, while it relieves the human frame from its most laborious efforts in printing, far exceeds all human powers in rapidity and despatch. That the magnitude of the invention may be justly appreciated by its efforts, we may inform the public that after the letters are placed by the compositors, and inclosed in what is called the 'forme,' little more remains for man to do than to attend upon and watch this unconscious agent in its operations. This machine is then merely supplied with paper, itself places the forme, inks it, adjusts the paper to the newly inked type, stamps the sheet, and gives it forth to the hands of the attendant, at the same time withdrawing the forme for a fresh coat of ink, which itself again distributes to the ensuing sheet, now advancing for impression; and the whole of these complicated acts is performed with such a velocity and simultaneousness of movement that no less than 1,100 are impressed in one hour."—The *Times*, November 29th, 1814.

I have said that some time after April, 1810 Koenig gave up entirely the idea of the modification of the screw press, and became a convert to the cylinder principle. It is alleged, with some background of justification, that Koenig borrowed the idea from Nicholson's patent of 1790. He certainly met Nicholson, who helped him to prepare his patents.

One other type of machine, constructed during the period ending 1814, remains to be mentioned. The printer of the *Norwich Mercury*, Mr. R. M. Bacon, together with Bryan Donkin, designed a machine in which the types were arranged and fixed on a revolving four-sided prism. The ink was applied by one roller, which rose and fell to meet the irregularities of the prism.

This patent, No. 3757 of 1813, contains the first reference to composition rollers, without which rapid machine printing would have been impracticable.

After Nicholson's, this was the first rotary machine as against the flat bed cylinder machines of Koenig.

It is difficult to say when Bacon and Donkin's machine was first used. The *European Magazine* for January, 1815, claims the invention for them as against Koenig, and goes on to state that another inventor had produced a printing machine at Plymouth "about ten years since, which has been and still is used by a tradesman there for printing his bills."

Koenig's final effort in this country was to transform his *Times* machine, which printed on one side only, into one that perfected the sheet or printed it on both sides

during the progress of the paper through the machine.

His patent for this is dated 1814. One large machine of this sort was made for Bensley in 1815, but it was too heavy and expensive, and this was the only one made. It produced 750 perfected sheets per hour, or 1,500 impressions.

Koenig finally left England in 1817, and started the firm of Koenig and Bauer at Kloster Oberzell, where it still flourishes.

The invention was now accomplished, machine printing was a fact, and although the hand press still held its own it must have felt the beginning of the severe competition.

We have followed the development of the flat bed cylinder machine for newspaper purposes to 1814. The machines then built by Koenig for the *Times* were used until 1827 (by 1824 they were printing 2,000 per hour), although Applegath and Cowper, who had succeeded Koenig at the *Times*, had modified them considerably.

In 1827 they built a new machine still printing on one side only, but raising the rate of impressions to between 4,000 and 5,000 per hour.

Perfecting had been abandoned. As Cowper says, "The principal object in a news machine is to obtain a great number of impressions from the same forme on one side of the sheet, and not from two formes on both sides as in books. This machine required eight attendants, four to lay on and four to take off. These machines were used by the *Times* until 1848, when the flat bed principle was finally abandoned.

The failure of Koenig's 1815 machine, for perfecting was not the end of perfecters. Applegath and Cowper turned their attention to this type of machine and considerably improved it. With little alteration it developed into the perfecter of recent times.

Up to 1850 the job or book printer was content to use the hand press and the power platen machine, and the big houses used the perfecters mentioned above. Here and there, of course, various experimental cylinder machines were used.

The invention by Main in 1850 of his cylinder machine formed the first step in the sequence of Wharfedale type machines. His cylinder did not rotate fully, but after making three-quarters of a revolution reversed itself and at the same time was raised to clear the type carriage on its return journey. The bed also had a new drive, being a crank with multiplying gear attached.

In 1848 news and book printing machines parted company. Applegath in that year introduced once more the rotary principle. The failures of Nicholson in 1790, and Bacon and Donkin in 1813, were at last avenged, and rotary printing has been the method for printing newspapers ever since that date. He placed a great cylinder with its axis vertical, and with as many faces as there were columns to be printed. The type was held by wedge-shaped rules, and as many feeders were arranged round the machine as the space permitted. The next improvement was the Hoe machine, where the axis of the main cylinder was horizontal and the type held by a special device known as the Turtle. These Hoe machines in this form lasted until 1868, when the final great invention in newspaper printing was introduced and the Walter press was set up.

Printing Types.

Turning to the types of this early part of the nineteenth century, as Mr. Talbot Baines Reed said, Bodoni and Didot killed the old style and left the modern Roman. But the new Roman had hardly established itself when a demand for fat face type arose. All the founders supplied the demand, and the specimen books of this period are full of types with these broad faces. The usual reaction set in, and from an attempt to condense type after the French fashion arose the Scotch letter. The English founders, however, retained the rounder forms of letters. The period about 1820 was noted for good printing, but the Roman type used was not as legible as the old style. Hansard said, in 1825, "the specimen of a British letter-founder is a heterogeneous compound made up of fat faces and lean faces, wide set and close set, proportioned and disproportioned." This style was maintained with some slight improvement as regards book faces until the forties.

For this period one is always told to refer to the Chiswick Press for the best printing, and the books issued by Pickering are generally referred to. The work of Charles Whittingham the elder, the founder of the Chiswick Press, possesses few claims to distinction. It was his nephew who founded the press at Took's Court, and to whom his uncle left the Chiswick Press. He it was who printed books for Pickering which have always been looked upon as excellent work. Corrall, who printed most of the Diamond Classics for the same publisher, also did good work, and here it was, no doubt, the publisher who was responsible for the excellence

of the volumes. Pickering was an artist in book production, and the simplicity and dignity of his publications had a great influence on the work of his time.

The combination of Pickering and the younger Whittingham produced most excellent results in later years; in fact, until the death of the former in 1854.

In 1844 Caslon's were asked to supply type for a Juvenal to be printed for Pickering in old-faced Roman. Caslon's discovered the old punches of the original Caslon's Roman type, from which a fount was cast. The Juvenal not being ready, the type was used for Lady Willoughby's Diary, published by Messrs. Longman in 1844, and at once the old face type became popular, and began to oust the compressed and fat face varieties. Some people, however, considered it somewhat too archaic, and Messrs. Miller & Richard began cutting a series of revived old style faces. They were followed by the other founders, and from about 1850 the better class of book work has been in one or other of these types.

Engraving and Illustration.

I have now to deal with the methods of illustration and engraving.

Bewick's development of illustration on wood gave an impetus to the art which lasted until the rise of the photographic reproduction processes in the middle 'eighties. It did not preserve the high character which Bewick gave it, but gradually degenerated into a trade. There was a slight revival, artistically speaking, about 1835, but the effect of this soon passed. Artisans had taken the place of artists.

Woodcuts, of course, could be printed at the same time as the text, and the whole history of illustration during the nineteenth century is a search after a process which would mechanically produce from pictures or drawings blocks which could be printed in the same way.

The invention of photography in 1839 led to no immediate result in this direction, although Fox Talbot and others thought and experimented much on the subject. However, the early history of the development of photographic engraving is dealt with in the next lecture. The period under discussion does not contain any real commercial development in this direction.

Lithography had been invented by J. A. Senefelder in two forms: engraving on stone in 1796, and the chemical method or true lithography in 1798. It is unnecessary to go into the history of this art, as Mr. Pennell has so recently and so elaborately explained it to you. It was brought to England in 1800, and gradually attained popularity. Its use for book illustration was not very frequent, as it necessitated two printings on different machines; and it was, therefore, not a formidable rival to wood engraving.

Occasional books occur with illustrations printed by unknown processes, such as acrography, which was probably a method of surface printing etchings.

Colour printing during the first half of the nineteenth century was almost entirely of an experimental character. Always there was the attempt to get a colour process that could be printed in the ordinary press or machine. Savage developed wood-block colour printing to an extent hitherto unknown, but with no commercial results. Baxter, of course, was the great colour printer of the period, and his work was special to himself. His delicacy of treatment and wonderful eye for colour, together with a patience that must have been almost superhuman, places his work in a different category from any other. It was a personality, not a process.

This hurried survey of a period roughly corresponding to the first half of the nineteenth century leaves printing at a point when it had definitely developed from the handicraft of 1800 into the machine industry. With machine-made paper and machine printing, it only wanted one thing to complete it--mechanical illustration. By this time it was well on the way, and the principal topic of my next lecture will be this final development.

THE OCCURRENCE OF ASPHALT IN THE STATE OF OKLAHOMA.

By Chas. N. Gould, Ph.D.

The asphalt deposits of the State of Oklahoma are among the most extensive in the United States. The majority of the known deposits occur in the southern part of the State. The greater part of the asphalt in Oklahoma is in the form of rock asphalt; in other words, it is rock impregnated with asphalt. In several cases, however, the material occurs in an almost pure, semi-viscous state. In other instances it is mined as a black, hard, and brittle substance known as grahamite, gilsonite, or impsonite, having the general texture and appearance of anthracite coal.

Pure asphalt or bitumen is derived from the natural or artificial distillation of petroleum. It is the last distillation product, the part that remains behind after all of the volatile oils and gases have

been distilled away. In many parts of the world, notably on the island of Trinidad, semi-liquid asphalt comes to the surface in great quantities and spreads out, forming a so-called lake. The evaporation on the surface forms a hard crust, but beneath the crust the asphalt is soft and viscous.

There are four chief modes of occurrence of asphalt as found in Oklahoma: first, as beds or sheets of pure asphalt interstratified between shales and sandstones; second, as impregnations of rock along fault lines; third, as impregnations of rock in regions of stratified rocks, vertically inclined; fourth, as impregnations in regions of level-lying strata. These four modes of occurrence will be discussed briefly.

In a number of localities in the Ouachita Mountains, in south-eastern Oklahoma, asphalt occurs in the form of gilsonite, grahamite, or impsonite. The material has been deposited in beds or sheets usually inclined at high angles, interstratified between shales and clays of the Carboniferous age. These beds are lenticular, sometimes as much as 20 ft. in thickness and occupying an area of several hundred feet in diameter. Frequently a series of these lenticular beds occurs in the same general region.

The material derived from those beds is black, hard, and brittle, breaking with a conchoidal fracture, having the general appearance of anthracite coal. The most extensive deposits so far discovered in Oklahoma are at the Jumbo Mine, in north-western Pushmataha County, and at Bunchtown, west of Tuskahoma. Deposits are known to exist at Page, in LeFlore County.

Much of the asphalt in Oklahoma occurs along fault lines, where the rocks have slipped up on one side and down on the other. At some unknown depth the faults or fissures have intersected beds carrying petroleum. This oil, being volatile and tending to escape to the surface, has travelled upward along the fault line. The lighter oils and gases have long since escaped into the atmosphere, while the heavier asphalt has remained behind and has impregnated the rocks on either side of the fissure. If the rock alongside the fissure happens to be a limestone the substance is called lime asphalt; if it is a sandstone, the material is a sand asphalt. So it will often happen that a bed of lime asphalt occurs beside a bed of sand asphalt, or *vice versâ*, the two beds being on opposite sides of the fault line.

The thickness of the so-called veins on either side of the fault lines varies from two or three feet to more than fifty feet. Usually the sandstone, which is the more porous rock, has been filled to a greater distance from the fissure than has the more impervious shale and limestone. The faults often extend along the surface for a distance of several miles. The depth to which the fissures extend is unknown, but in some cases, as shown by drilling, it is at least 1,000 ft. These faults are most abundant in the Arbuckle Mountains, in Murray, Johnston, and Pontotoc Counties.

There are several regions in southern Oklahoma, particularly in Carter, Atoka, Pushmataha, and LeFlore Counties, where the rocks have been tilted on edge, and afterwards truncated, leaving the upturned edges exposed on the surface. These rocks consist largely of alternating layers of shale and sandstone. Many of the sandstones are known to contain asphalt. These ledges vary in thickness up to 100 ft., and in many cases the greater part of this thickness of sandstone has been impregnated with asphalt. In a number of cases this material has been mined and utilised for road building, street paving, and other purposes.

Throughout many parts of the State asphalt occurs in rocks which lie approximately level. At least three separate regions in the State contain deposits of this character.

In a number of the southern counties of Oklahoma there are certain deposits of Cretaceous age, which lie level or dip at low angles to the south. The basal member of the Cretaceous, known as the Trinity sand, is a formation several hundred feet thick, composed chiefly of loosely-consolidated sands. Immediately above the Trinity is a limestone, also of Cretaceous age, known as the Goodland limestone. In many localities asphalt occurs in the rock at the top of the Trinity sands, and immediately below the Goodland limestone. Deposits of this kind occur near Tishomingo, Bennington, and Bokhoma.

Asphalt occurs in level-lying rocks in several counties lying south and west of the Arbuckle Mountains, and in the region surrounding the Wichita Mountains. As here exposed it is contained in ledges of sandstone of Carboniferous age, which were formerly buried at considerable depths beneath the surface, and which, at that time, doubtless were oil sands. As the surface has been brought down by erosion, exposing the various sandstones containing the hydro-carbons, the lighter and more volatile of these substances have escaped, and have been dissipated into the air, leaving behind the involatile residue known as asphalt. Drilling in this general region reveals the presence of a number of ledges of sand, all the way down to 1,000 ft., all of which contain considerable amounts of oil and gas. The Healdton, Loco, Lawton, Duncan, and Gotebo oil and gas fields, in south-western Oklahoma, are located in regions where conditions are as outlined above.

A third region in Oklahoma where asphalt occurs, in rocks lying approximately level, is in the north-eastern part of the State, where the oil sands of the Mid-Continent field outcrop on the surface. There is a region west of the Grand River, extending from the Arkansas River north to the Kansas line, containing numerous deposits of asphalt and oil seeps and springs. This material escapes from certain sandstone ledges, Carboniferous in age, which are carried beneath the surface by the western dip of the rocks, and which, when penetrated by the drill at points twenty to one hundred miles west and south-west of

the outcrop, produce large quantities of oil and gas.

Analyses of the rock asphalts of Oklahoma show that the composition of the material varies considerably. The so-called lime asphalt contains all the way from 2 to 10 per cent. bitumen, the remainder being calcium carbonate. The sand asphalt runs usually from 10 to 20 per cent. of bitumen, while the shale asphalt usually contains less than 5 per cent. of hydro-carbons.

Asphalt has been utilised to a limited extent for the manufacture of paints, varnishes, and roofing; also quite extensively for street paving and road making. It has been demonstrated that a mixture of the lime and sand asphalt makes the best paving.

The amount of the material available in Oklahoma is practically inexhaustible, but only a relatively small amount has been utilised.

THE BRITISH IN BUSRAH.

The capture of Busrah within seventeen days of the declaration of war on Turkey solves the question of the sovereignty of a port of great importance to Great Britain's commerce in the East. As the chief port of Baghdad it has long possessed value in the eyes of all, whether Europeans or Turks, interested in the trade of Mesopotamia and contiguous regions. In the middle of the eighteenth century the East India Company established an English factory there, and even now considerable trade is carried on with Hindostan, while trade with the interior is maintained by means of caravans to Aleppo and Baghdad, whence goods are conveyed to Constantinople. The Turkish domination dates from 1660, but since that time Busrah has passed through many vicissitudes, passing into the hands of the Persians in 1777, and for a year or two after into those of the Montefik Arabs, who occupy the desert to the south-west. The political position of Busrah is of some considerable importance, especially because it will in all probability form the terminus of the Baghdad railway, and perhaps also the eastern objective of the proposed trans-Arabian railway from Port Said to the Persian Gulf. The town is unhealthy, and most of the Europeans reside at Maghil, which has been built on a less fever-stricken site. The adjoining country is fertile, and wheat, rice, barley and dates of varied and excellent quality, besides fruit, such as apricots, apples, figs, olives, pomegranates and grapes, and vegetables, are cultivated in great quantities. There are also extensive fields of roses, raised for the manufacture of attar. Some eight months ago a series of outrages had been perpetrated on British subjects, culminating in the murder of the captain of a British steamer plying on the Shat-el-Arab. Had the Turkish authorities grappled earnestly with the situation the Arab agitators and other lawless elements might have been restrained, but no genuine regret was shown by the Turks, and since the outbreak of the war the Germans have done all they can to strengthen the footing that the agreement to locate the terminus of the Baghdad railway at Busrah had given them. The loss of the town is, therefore, a blow to both Berlin and Constantinople, and the fact that the victors are an Indian force adds to the prestige of the Government of India in a region where British-Indian commercial interests particularly require watching and support. Apart from the Baghdad railway, Busrah is the contemplated terminus of the trans-Arabian line, as already mentioned, and our influence over Kowcit, the alternative port at the head of the Persian Gulf, would be a great assistance in the expansion of trade in this important region.

Since the beginning of 1914 the trade in petroleum has developed, the Anglo-Persian Oil Company having maintained a strong hold on the local market, and gained immediate popularity in respect of price and quality. During 1913 twenty German steamers of the Hamburg-America Line called at Busrah, and German returns gave the value of imports for Busrah and Baghdad at close on £2,000,000, as compared with about half that sum in 1912. The imports included about 34,000 tons of material for the Baghdad railway, while the remainder consisted chiefly of sugar, haberdashery, liquor, beer and spirits, steel and brassware, soap, paperware, glass and matches, as well as cement and lime for building purposes. The still more recent capture by the British of Kurna is a welcome reply to the closure by the Turks of that port to all foreign shipping in 1913.

NAVAL CONSTRUCTION IN EUROPE.

The *Rivista Marittima*, in a recent issue, gives the following statistics showing the activity displayed by the various belligerent Powers in the construction of warships at the present time.

The particulars relating to the British Navy should be too well known in this country to need reproduction here.

At the present time, France has 12 armoured ships in construction, of which 3, viz., "La Bretagne," "La Provence," and "La Lorraine" (of 23,500 tons displacement), will be ready for sea early this year; 5, "La Normandie," "La Gascogne," "La Flandre," "La Languedoc," and "La Bearn" (of 25,200 tons each), are already launched, and will be completed in 1916; 4, "La Duguesne," "La Tourville," "La Lyon," and "La Lille" (of 29,500 tons each), will be launched in about two years' time, and ready for sea in 1917.

In addition to these, there are 3 cruisers (of 4,500 tons) which will be launched this year, and completed by 1916; 5 torpedo-destroyers, of which 3 will be ready this year; 22 submarines, 10 of which are almost completed, and 8 will be ready during the course of the present year.

France has sixteen Government dockyards and eight private yards where these vessels are being constructed.

Russia has 12 armoured ships in construction: 4 of these (of 23,400 tons each) have already been launched, and will be completed this year; 4 others (of 22,900 tons), also launched, will be ready for sea in 1916; whilst the remaining 4 (of 32,400 tons), still on the stocks, will be completed by the same period.

Besides these, she has 8 cruisers (of 7,000 tons displacement), which will be ready in 1916. She has also 8 cruisers (of 7,000 tons each), which will be ready in 1916; 49 torpedo-destroyers, of which 24 will be completed this year, and 25 others in hand; also 25 submarines, 15 of which number will be ready this year.

Russia has sixteen Government dockyards and sixteen private yards.

On the other side, 7 armoured ships are being built for the German Navy, 3 of which (of 27,000 tons) will be completed in 1916; while 2, viz., the "Kronprinz" (of 25,800 tons) and the "Lützow" (of 26,500 tons), have both been launched, and probably will be ready for sea this year. Of the other 2, no particulars are given. Besides these, 17 torpedo-destroyers and 7 submarines are in construction, and will probably be ready for sea in the course of the next twelve months.

Germany has five Government and ten private yards for the construction of her warships.

In the Austro-Hungarian empire, which possesses only one Government dockyard and eight private ship-building establishments, 3 armoured cruisers are in hand, one of which, the "Szent Isvan" (of 20,500 tons displacement), is nearly ready for sea, and the other 2 will probably not be completed till 1917. In addition, 3 cruisers, 2 of which, it is stated, are nearly ready, 6 torpedo-destroyers, 27 torpedo-boats, and 5 submarines complete the list of vessels now in hand in that country.

BELGIAN INTENSIVE CULTURE.

The *Times* announces that agricultural experts among the Belgian exiles in England have offered to disclose the secrets of their highly successful system of intensive culture for the benefit of British small-holders. The suggestion came from the Queen of the Belgians, who thought that the instruction might be accepted as a token of the gratitude of the Belgians for the refuge and hospitality they have found here in their dire distress. The Belgian Government have approved the scheme. They are naturally anxious that no undertakings should be entered into by their people which would ultimately hinder their repatriation when the time comes for their return to Belgium, but they are of opinion that that objection does not apply to experiments in intensive culture in this country.

Accordingly a committee has been formed to carry out the scheme. The chairman is Sir Richard Paget, 9, King's Bench Walk, Temple. It includes Lord Milner, Lord Grey, Sir Horace Plunkett, Lady Lugard, Lady Lovelace, Lady St. Helier, Mr. Christopher Turnor, Sir Robert Turnbull, Mr. Cecil Harmsworth, M.P., Mr. Prothero, M.P., and several other representatives of agricultural, small-holdings, town-planning, rural housing, and co-operative associations. The committee propose to form themselves into a non-profit society to be called the Belgian Organisation Society.

It is proposed that the agricultural refugees should be found temporary employment on general agricultural work, such as reclaiming waste and cleaning foul lands, so as to prepare these for intensive cultivation, and that as soon as possible a selection should be made of those families who have had a thorough experience in the working of the Belgian system to give local demonstrations, or set up agricultural settlements on co-operative lines. The Belgian Government have given to the committee the services of a number of their official experts in market-gardening, the rearing of poultry, and the planting and cultivation of trees, and have promised that these services will be continued until the scheme is placed on a practical working basis. The committee have in turn invited the assistance and co-operation of the county councils and the agricultural colleges. It is also proposed to add to the settlements a certain number of British small-holders, who will learn the system and carry on the work after the Belgians have gone home. On suitable soil the Belgians can grow as many as five successive crops in the year under glass. The necessary plant is of the simplest kind, being chiefly plain sheets of glass in rough wooden frames, which are made by the cultivators. The improvement of the soil is a special study with them. In fact the greater part of the soil of the Belgian market gardens has been made on waste and barren ground by the cultivators themselves.

The committee hope to get the funds for starting the scheme from two sources. The Board of Agriculture have suggested that they might apply to the Development Commissioners for grants for the local demonstrations of intensive culture, as the object is educational. As regards the housing of the families constituting the co-operative settlements, temporary accommodation will have at first to be found; but it is hoped that when the schemes have been started the means for providing permanent housing will be obtained under the provisions of the Housing (No. 2) Act.

THE INTRODUCTION OF AMERICAN COTTON INTO SIND PROVINCE, INDIA.*

The cultivation of cotton in Sind has extended considerably during the last few years, and the annual production is now about 150,000 bales. The Sindhi variety yields a short, coarse, strong cotton of good bright colour, which realises about

* Abstract of a paper read by G. S. Henderson, Deputy Director of Agriculture, Sind, at the Third International Congress of Tropical Agriculture.

5½d. per lb. with Middling American at 7·30d. per lb.; the ginning yield is about 33 per cent. The method of cultivation consists in sowing the cotton broadcast after irrigation, and ploughing it in; subsequently the crop receives no attention except one or two hoeings and occasional irrigation.

In attempting to improve the cotton of Sind, superior Indian varieties were first tried, but were soon discarded in favour of exotic kinds. The Department of Agriculture found that Egyptian cotton succeeded on the Government farms, and afterwards 4,000 acres were planted on the Jamrao Canal. The crop was of good quality, but was difficult to dispose of, as the Bombay mills do not use Egyptian cotton. Egyptian cotton has moreover the disadvantages that it requires more careful cultivation than Sindhi and has a long growing period, which practically restricts its growth at present to the Jamrao Canal area.

Some years ago trials were made with American cotton, and it was found that this had the advantages of having a short growing period (thus enabling it to be grown on the common inundation canals), of giving a yield per acre equal to that of the Sindhi cotton, of being hardy and amenable to the method of cultivation employed for the Sindhi variety, and of being more easily marketed than Egyptian cotton. The author, during a visit to the cotton-growing regions of the United States, selected the "Triumph" variety as being the most suitable for Sind. This plant bears large bolls, matures early, gives good yields, and is well adapted for growth on irrigated lands. After repeated experimental trials at the Government farms, it was decided to grow the variety on a large scale, and, early in 1913, 30 tons of seed were distributed in the Jamrao area and 10 tons in Sukkur and Upper Sind Frontier. A syndicate of Bombay millowners was formed to buy, gin, bale, and dispose of the crop derived from this seed. The crop amounted to 511 bales, and was sold in Liverpool at an average price of 1d. per lb. below that of Middling American.

Seed for planting 6,000 acres has been distributed this year (1914), and it is expected that with better ginning the product will be of equal grade to Middling American. A seed farm of 200 acres has been started by the Agricultural Department in order to prevent deterioration of the stock.

THE DEVELOPMENT OF THE TEXTILE INDUSTRIES.

Reduced Imports.—The time would seem to have arrived at which the interference with foreign manufacturing arrangements should be leaving visible gaps for British manufacturers to fill. A glance at the import statistics does not destroy that impression. In the four months August–November, 1913, yarns and fabrics valued at £15·2 millions were imported into this country. The corresponding figures for 1914 are £6·5 millions, and it may be thoroughly believed that no reduction of expenditure or decrease in re-exports accounts for the full difference. After making certain allowances under these heads, a remainder exists representing trade which the English producer might transact. The visible opportunities are greater in some directions than others, although there is a remarkable resemblance between the amounts of the falls in the three principal classes of trade. In cottons, in the four months, imports have been £2·8 millions less, in woollens £2·5, and in silks £2·2 millions less. Closer discrimination is needed to bring out the position of the fully-manufactured classes, but as general evidence of the scope afforded in the home market these overhead figures may serve.

Natural Delays.—For several reasons the new opportunities created by a violent crisis do not make themselves perceptible all at once. Existing stocks of imported goods tide over their owners for a time. There is a universal ignorance as to what may happen next, and a doubt of what had best be done which clears only by degrees. The prevailing uncertainty powerfully affects goods known to be procurable upon request; much more those which are neither known to be wanted nor to be obtainable. If a few months slip by before all concerned become conscious of a new stir, the fact should not be surprising, although comment upon the absence of demand in replacement of foreign articles has been heard. Thus an English silk-spinner has been known to lament that nothing deserving of the slightest notice had happened to promote demand for spun silk yarn, although some £14 millions of various sorts of silk are imported with regularity. It is apparent that France and Switzerland have continued to furnish the English market with reduced but still considerable supplies, and it is to be supposed that before the English silk-spinner can derive appreciable benefit a sale of woven goods somewhat different in character from the imported sorts must be set in motion. The sale may be coming, but it has not yet definitely arrived.

Foreign Cottons and Woollens.—In the four months imports of cotton yarn, probably because of the occupation of Belgium, have been cut down from £206,000 to £48,000. Those of cotton piece goods and hosiery have been reduced from £819,000 to £326,000, and those of cotton lace from £682,000 to £238,000. The items are minute in the general perspective of cotton affairs, although the reduction is in a large enough proportion to be appreciable in some quarters. Still more tangible in practice should be the fall in imports of wool goods, a fall that means a change from £3·3 millions to only £826,000. In this line of business the absence of the foreign competitor is made noticeable chiefly by inquiries from merchants for cloths of the German and French type. The goods are woven from mule-spun yarns in contrast to the regular frame-spun British articles. Samples of fine German, Austrian and Belgian worsted coatings have been circulated by merchants, but these are of less consequence than the dress goods, of which

sixty million yards per annum have been imported into England latterly, and of which large sales are made also in other countries by Continental manufacturers. Wool dress goods of the kind chanced to be in first favour before the opening of the war, so that the desire to supply the market with fabrics of that class is particularly marked.

Differences of Machinery.—The quantity of machinery in this country available for spinning wool yarns required for dress goods of the Continental type is negligible. The machines are relatively expensive in themselves and in their housing, as they occupy large floor-space. It is thus not readily practicable to discard frames and instal mules, and there is no chance of this being done. Mills would require to be built for the purpose and workpeople to be found, and although no doubt exists of the profits to be picked up in the present, the future is uncertain. The experience of some owners of both types of machine is that the worsted frame has been more remunerative than the worsted mule. A sound yarn is made on the mule of greater fineness than can be made on the frame from fibre of the same length. The mule yarn is more supple, having less twist; and while each sort has its advantages, the balance of English opinion has favoured frame yarn as the more serviceable of the two in English conditions. The courageous course of erecting new mills is open to those who choose to adopt it. Short of that course, the choice lies between finding new employment for frame-spun yarns or utilising existing machinery to duplicate mule yarn as nearly as is possible.

Imitation Yarns.—In several directions ingenuity is hard at work to provide wool yarns of the Continental character with the aid of existing machines. A signal success that has been scored in one quarter is understood to be due to the employment of wool of a particular class, and to the use of worsted and cotton machinery in combination. Wool and cotton in the form of rovings are placed upon the cotton mule, and are spun into a mixed wool and cotton yarn that is almost indistinguishable in its main characteristics from an all-worsted yarn spun upon the mule without oil. The article imitates what is called in the trade "French dry-spun," and a great demand has sprung up for the product. This development may easily prove the starting-point of a large manufacture of cloths at a popular price and of the softness and fullness desired. The result of other efforts is awaited, and it is not too much to expect that they will go some way towards the goal, even if the outcome is something that is neither Continental nor English, but midway between these types. After trade openings have been made and been noticed, a time necessarily elapses before all the technical problems that are involved in making goods of a new type can be satisfactorily worked out. The influences of fashion and of season enter into the case, and for all reasons the suspension of competition may be counted on to produce larger effects than have been felt hitherto.

Mercerising in Acid. Over forty years passed before John Mercer's patent of 1850, for the action of alkalies upon vegetable fibres, was exploited with the object of improving the lustre of cotton yarn. Once afoot, the new process of mercerising extended rapidly, and there is almost no end to the number of handkerchiefs, linings, embroidery threads, warps, and so forth that are treated by the caustic soda process. The goods are immersed in a strong lye at a low temperature, with the effect that they contract, if allowed, become gelatinous and translucent in appearance, and gain a marked affinity for dyestuff. Other reagents than caustic soda have been proposed at various times, but it is probable that none other is used, and its cost is economised by recovery of soda from the spent liquor. The trouble of effectively neutralising and washing out the alkali, which in earlier days led to the rotting of goods treated by the process, is no longer felt, and the method has long been perfectly systematised and understood. Professor Knecht has shown recently that strong acid may be substituted for strong alkali, and it will be interesting to see how his process progresses in practice. Hydrochloric acid of 37-38° Twaddel is used in the bath, and is effective in thirty seconds. It is found that the acid does not enfeeble the fibre, is easily washed out, and is cheap, albeit the acid is not a commercial article in this strength.

British Dyestuffs.—British dye manufacturers hold out some hope of overtaking the demand for their present products in a month or so. Their facilities have been very heavily overtaxed in keeping the dyeing trade going, and their plants are being largely increased. Messrs. Read, Holliday & Sons, Ltd., of Huddersfield, whose works are to form a nucleus for the national colour-manufacturing scheme, are extending their premises over 15½ acres. Some smaller concerns are growing also, and there are prospects of the foundation of a new enterprise by firms who have hitherto acted as German agents in this country. The position of dyers in respect of stock on hand and contracts of delivery doubtless differs from case to case, but some of them are able to see their way forward for as far as one year. Aniline and naphthalene dyestuffs continue to filter in from Switzerland, where there are important works, and the supplies from foreign sources in the four months August-November have been some 19,000 cwt. as compared with 92,400 cwt. in the equal period of 1913. Dyers have had to refuse to bind themselves to deliver goods dyed to any shades that a customer may at any time choose to send, but thus far everything needing dyeing has been dyed in one manner or another, and the dread prospect of having to wear white or natural colours is indefinitely postponed.

NOTES ON BOOKS.

Liquid Drops and Globules. By Charles R. Darling. London: E. & F. N. Spon, Ltd. 2s. 6d. net.

In this little volume Mr. Darling has collected three lectures delivered to popular audiences. They deal with the formation and movements of liquid drops and globules, and with the phenomena connected with the surface skin of water and other liquids. The subject is one that, in the hands of a clever manipulator, lends itself to some beautiful experiments. Particularly pretty are those of the diving drop of dimethyl-aniline, the automatic drops of aniline, and the orthotoluidine globules on a water surface. Mr. Darling gives a very clear account of these, and a short appendix contains a list of the necessary materials, which are of a surprisingly simple nature. Any boy with a taste for science into whose hands this book may fall will almost inevitably be impelled to try the experiments described. He may not find them quite so easy to carry out as they appear to be when Mr. Darling is the manipulator, but if his interest is aroused, and he is led to a further study of the subject, the book will not have been written in vain.

Magnetism and Electricity. By S. S. Richardson, B.Sc., A.R.C.Sc. New and Revised Edition. London: Blackie & Son, Ltd. 4s. 6d.

In preparing the second edition of this work Mr. Richardson has revised the whole of the text, and re-written a considerable portion of it, with the result that it is now a very clear hand-book for the student who is preparing for the Board of Education Examinations, or for the Intermediate and the greater part of the Final Pass Degree Examinations of the Universities. A fresh chapter has also been added dealing with the principles underlying the actions of dynamos and motors. The author, as the head of the Physics Department of the Central Municipal Technical School of Liverpool, has a very accurate knowledge of the needs of students, who will find in this volume a lucid and efficient guide to the study of electricity and electrical measurements.

GENERAL NOTES.

Sugar-beet Culture.—An attempt is being made by the London and South-Western Railway Company to encourage sugar-beet culture in the south-western counties. The *Times* states that the company has had an extensive survey made of the soils in the counties of Surrey, Hants, Wilts, Dorset, Somerset, Devon, and Cornwall, and it is declared that large areas in these counties are thoroughly suitable for the cultivation of beet. The next step was to get the necessary co-operation between the farmer, the carrier, and the manufacturer. A meeting of Wiltshire landowners and farmers has already been held at Salisbury. Many of the leading farmers of the district were present, and addresses were given by Mr. Cadogan Rothery and other experts. It was announced that, given the requisite production of beet, the capital for the foundation of a factory (some £130,000) would be forthcoming, and every accommodation in the way of sidings and carriage facilities would be provided. Similar meetings are to be held early in the new year at Basingstoke, Fareham, Winchester, and possibly at Yeovil and other centres; at each of which the case for beet culture will be placed before the landowners and farmers, while each meeting will be prepared for, as the Salisbury meeting was, by the issue to all concerned of the company's booklet on the subject. The difficulty hitherto experienced in attempts to introduce the industry to England has been in the provision of the large capital required for each factory, which cannot be raised without a guarantee of sufficient permanent production from the locality. The peculiar circumstances of the time have made it possible to arrange that all capital required can now be raised. The result of the Salisbury meeting was that the matter was referred to the South Wilts Chamber of Agriculture.

The Brent Valley Bird Sanctuary.—At a recent meeting of the Linnean Society Mr. Wilfred Mark Webb described the circumstances under which the Brent Valley Bird Sanctuary came into existence. He said that twelve years ago the Brent Valley Branch of the Selborne Society took steps to protect a wood of nineteen acres in its district, not far from Ealing, which had long been known as an abiding place for birds. The immediate object was to preserve the nightingales; and a small committee was formed to approach the tenant of the farm on which the wood was situated with a view to the appointment of a watcher. Ultimately, the committee appointed its own keeper, took over the wood from the farmer, and now rents it direct from the owners. No very rare birds occur in the wood, but it is important in the neighbourhood of large towns to give an opportunity to the commoner kinds of nesting undisturbed. Forty-one species have been recorded as breeding in the wood, thirty-nine of them during recent years. Among these may be mentioned the nightingale, lesser white-throat, the blackcap, garden-warbler, chiffchaff, willow-warbler, long-tailed tit, marsh-tit, tree-creeper, hawfinch, goldfinch, redpoll, nuthatch, wryneck, cuckoo, red-backed shrike, turtle-dove, and wild duck. Including the winter migrants and occasional visitors, eighty-eight species have been observed in or close to the wood. Of these the golden-crested wren, all the three British woodpeckers, the nightjar, the brown owl, the barn owl, the snipe, and the kingfisher are seen commonly or from time to time. Owing to the introduction of nesting-boxes, several species have increased in numbers or have been induced to nest. Mr. Webb also pointed out that the work of the committee

had spread far beyond the confines of the wood, as many visitors and others had been provided with boxes by the committee, which was led some three or four years ago to make an effort to replace the boxes imported from Germany by English-made ones, which were considered to be of improved pattern. The expenses of the wood have been met by voluntary contributions and with the profits made by the sale of the nesting-boxes. It may be added that boxes have been sent to China, America, Italy, to the Pyrenees, and to France.

Nipa Palm Sugar.—An article in the *Philippine Journal of Science* gives some information concerning the nipa palm (*Nipa fructicans*) as a commercial source of sugar. The palm covers some 45,000 acres in the Bulacan and Pampanga provinces of the Philippines alone. Hitherto the sap exuded by the flower-stalk has only been utilised on a large scale as a commercial source of alcohol; it was examined by the writers of the article with regard to the possibility of extracting the sugar contained. The yield amounts to about 9½ gallons per tree per season, or, with 750 trees per hectare, to 2,650 gallons per acre. As it flows from the palm the sap contains about 15 per cent. of saccharose, and has an apparent purity of not less than 85, only traces of invert sugar being present. The addition of about ·5 per cent. of sodium chloride slightly reduces the purity; but waxes, acids, pectins and other foreign materials are practically absent. The sap contains active enzymes of the invertase and peroxidase types, the latter being present only during the final period of secretion and being capable of oxidising sucrose and invert sugar in neutral or alkaline solution.

Embargo on Exports of Dyestuffs from Italy.—It appears, from a memorandum issued by the *Museo di Commercio* of Milan, that the embargo on the exports of certain dyestuffs from Italy has been partially removed. The export of tannic acid is now permitted, but is restricted in quantity to that exported in 1913, which amounted to 258,479 quintals (25,145 English tons), or on the average of 21,290 quintals (2,095 tons) per month. The re-exportation of valonia, which comes from the Levant and principally Turkey, however, is still strictly prohibited.

The Port of Zeebrugge.—The following particulars respecting the little port of Zeebrugge, given by the Parisian journal *Le Temps*, will be of interest at the present time. As a base for submarines, this place was seized by the Germans as a favourable station for their raids in the Channel. Their plans have, fortunately, been frustrated by the recent bombardment by British ships. The outer harbour at Zeebrugge, at the entrance to the ship canal to Bruges, was opened in 1907. It is formed by a curved breakwater 2,487 metres (2,700 yards) in length, extending into the sea, and enclosing an area of 138 hectares (340 acres) of water, with a depth varying from 8 to 9½ metres (26 ft. 3 ins. to 31 ft.) alongside the quays, and affords a safe shelter for ships of large tonnage. The ship canal to Bruges, a distance of about 15 miles, is 70 metres (230 ft.) wide at the water level, and a depth of 8 metres (26 ft. 3 ins.). The cost of the work, which occupied thirteen years in construction, amounted to 50 millions of francs (2 millions sterling).

Cost of Reinforced-concrete Bridges.—In the course of a paper read before the Institution of Civil Engineers, Mr. J. B. Bull gave some information regarding the cost of reinforced-concrete bridges erected during the last six years by the Great Central Railway Company, A three-span bridge at Ashton-under-Lyne, reinforced with round bars on the Hennebique system, cost £5,917. The estimated cost of a similar structure in steel and masonry was £8,390. A bridge carrying a new road and tramway over the Grimsby district light railway, also designed on the Hennebique system, cost £2,939. The estimated cost of a similar structure in steelwork and masonry was £3,500. Four high-level railway bridges at Immingham Docks cost, on an average, £3,024 each. Similar structures in steelwork and masonry were estimated to cost £3,800 each.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock:—

January 20.—J. A. Hunter, "The Textile Industries of Great Britain and of Germany." Lord Rotherham, President of the Textile Institute, will preside.

January 27.—Hon. John Collier, R.O.I., "Portrait Painting." Lord Sanderson, G.C.B., K.C.M.G., will preside.

February 3. — Octavius Charles Beale, Chairman of the Australian Manufacturers' Association, "Imperial Industrial Development after the War."

February 10.—F. Vincent Brooks, "British Lithography in 1915."

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

January 21.—Henry John Elwes, F.R.S., "Nepal." The Right Hon. Sir Herbert Maxwell, Bt., F.R.S., will preside.

February 11. — Captain Sir George Duff Dunbar, Bt., I.A., "Tribes of the Brahmaputra Valley."

March 18. — Lieut.-Colonel A. C. Yate, I.A. (retired), "The Indian Army."

April 15.—M. M. S. Gubbay, I.C.S., "Indian Trade and the War."

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

JANUARY 26.—MAJOR E. H. M. LEGGETT, R.E., D.S.O., Managing Director of the British East Africa Corporation, "The Economic Development of British East Africa and Uganda."

FEBRUARY 2.—EDWARD R. DAVSON, "Sugar and the War."

Dates to be hereafter announced:—

THOMAS WORTHINGTON, "The Work of the Commercial Intelligence Branch of the Board of Trade."

T. THORNE BAKER, "The Industrial Uses of Radium."

FRANK BAINES, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

E. W. HULME, "Patent Law."

H. M. THORNTON, "The Industrial Uses of Coal Gas."

D. Y. CAMERON, A.R.A., R.E., "Etching."

ROGER FRY, "Post Impressionism in Design."

C. H. SHERRILL, "Ancient Stained Glass."

A. S. E. ACKERMANN, B.Sc., Assoc.M.Inst.C.E., "The Utilisation of Solar Energy."

LADY LUGARD, "The Work of the War Refugees' Committee."

WILLIAM POEL, "Shakespeare's Profession."

ARTHUR WILCOCK, "Designing for Textiles."

CHARLES R. DARLING, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—
April 15, May 13.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—
March 2, 30, May 4.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

DR. F. MOLLWO PERKIN, F.I.C., F.C.S., "Oils, their Production and Manufacture." Three Lectures.
January 18, 25, February 1.

M. H. BAILLIE SCOTT, "House Building—Past and Present." Three Lectures.
March 15, 22, 29.

DAVID SOMMERVILLE, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.
April 26, May 3, 10, 17.

FOTHERGILL LECTURES.

Monday evenings, at 8 o'clock:—

PROFESSOR VIVIAN B. LEWES, F.I.C., F.C.S., "Motor Fuel." Three Lectures.
February 15, 22, March 1.

JUVENILE LECTURES.

Wednesday afternoons, at 5 o'clock:—

H. PLUNKET GREENE, "How to Sing a Song." Two lectures, with vocal illustrations.
January 6, 13.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JANUARY 4...Victoria Institute, Central Buildings, Westminster, S.W., 4.30 p.m. Professor D. S. Margoliouth, "The Life Work of Homer."

Geographical Society, Town Hall, High-street, Kensington, W., 3.30 p.m. (Juvenile Lecture.) Mr. C. Carus-Wilson, "The Earth's Unstable Crust."

Chemical Industry, Society of (London Section), Northampton Polytechnic Institute, Clerkenwell, E.C., 8 p.m. Mr. E. Kilburn Scott, "Production of Nitrates from Air, with special reference to a New Electric Furnace."

TUESDAY, JANUARY 5...Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Professor C. V. Boys, "Science in the Home. Lecture IV.—Heat in the Home."

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 3.30 p.m. (Juvenile Lecture.) Mr. R. Kearton, "Wild Beasts and Birds of the British Empire."

Röntgen Society, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 8.15 p.m. Discussion on the "Localisation of Foreign Bodies by X-Rays."

WEDNESDAY, JANUARY 6..ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 5 p.m. (Juvenile Lecture.) Mr. H. Plunket Greene, "How to Sing a Song." (Lecture I.)

Geological Society, Burlington House, W., 8 p.m. 1. Mr. C. I. Gardiner, "The Silurian Inlier of Usk." 2. Mr. J. R. Haselhurst, "Some Observations on Cone-in-Cone Structure, and their Relation to its Origin."

Civil Engineers of Ireland, Institution of, 35, Dawson-street, Dublin, 8 p.m.

Sanitary Engineers, Institute of, Caxton Hall, Westminster, S.W., 8 p.m. Presidential Address by Mr. A. P. I. Cotterell.

THURSDAY, JANUARY 7... Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 3.30 p.m. (Juvenile Lecture.) Mr. W. H. Garrison, "The World's Greatest War."

Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Professor C. V. Boys, "Science in the Home. Lecture V.—Electricity in the Home."

Concrete Institute, 296, Vauxhall Bridge-road, S.W., 7.30 p.m. Mr. H. J. Tingle, "The Application of Concrete in Modern Sanitation."

FRIDAY, JANUARY 8...Geographical Society, Town Hall, High-street, Kensington, W., 3.30 p.m. (Juvenile Lecture.) Rev. T. T. Norgate, "The Theatres of War Illustrated."

Geologists' Association, University College, W.C., 8 p.m. Miss G. L. Elles, "The Value of Graptolites to the Stratigraphical Geologist."

Journal of the Royal Society of Arts.

No. 3,242. VOL. LXIII.

FRIDAY, JANUARY 8, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, JANUARY 13th, 5 p.m. (Juvenile Lecture.) H. PLUNKET GREENE, "How to Sing a Song."

The lecture will be accompanied with numerous vocal illustrations.

Further particulars of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

On Wednesday afternoon, January 6th, Mr. H. PLUNKET GREENE delivered the first lecture of his course on "How to Sing a Song."

The lecturer began by considering what special gifts a public singer must possess in order to attain success on the platform, and how these gifts must be trained. As an instance of the singing possibilities that lurk in the majority of people, he mentioned the case of a Liverpool man who undertook to train some children to sing. At the beginning of their course they had not even the most rudimentary notions of music. He began by teaching them the meaning of the words of their songs and the beauty of the ideas which they expressed; he then gradually led them on to see how this beauty could be magnified by the music, and by the end of a year they were able to sing with feeling and expression.

In singing, said Mr. Plunket Greene, there were two problems: first, how to sing at all, *i.e.*, how to make the sounds; and, second, how to use those sounds when one had learnt to make them. That afternoon he proposed to deal mainly with the first problem; in next week's lecture he would discuss the second. There were four things, apart from the voice, which a singer must possess. (1) He must be master of his technique; he must know how to breathe properly, and how to pitch his voice in the right place—the tip of the tongue; he must be able to sing fast or slowly with equal ease, and he must always take care to make the words absolutely clear. (2) Every song has its own atmosphere, and this he must be able to realise and express. He must think of the song as a whole, and to do this effectively he must possess imagination. (3) He must be able to express tone colour; and (4) he must possess magnetism. This was essentially an individual gift; it was a difficult thing to define, but it meant in effect that the fortunate singer who had it and his audience were at once on friendly terms.

Having discussed and illustrated the qualities of a successful singer, Mr. Plunket Greene next proceeded to lay down the three principal rules which he must faithfully observe. In the first place, he must never stop the march of the song—that is to say, he must never break the rhythm in order to take breath. He must learn to manage his breath so that he can take it when the rhythm permits. Secondly, he must rememember that he is not the only person to be considered when singing a song. The song begins as soon as the first note is played on the piano, and it does not end until the last note has sounded. The accompaniment is just as important as the words, and the accompanist as the singer. Lastly, a singer should remember that the speech he sings is the same as that which he talks: there should be no fanciful pronunciation of words for the supposed reason that some sounds which can be spoken quite well cannot be easily sung. He quoted a number of instances in which the drawing-room singer is apt to travesty the English language, and finally, in illustration of his various points, he sang the following songs:—

1	The Hurdy-Gurdy Man	Schubert
2	Cradle-Song of the Shepherds at Bethlehem	Chr. Dan. Schubart (1791)
3	Did you ever?	C. V. Stanford
4	The Sands o' Dee	Frederick Clay
5	The Song of Momus to Mars	Dr. Boyce (1750)
6	Speed on, Engine	Francis Korbay
7	The Crow	C. V. Stanford
8	The Kilkenny Cats (Old Irish)	*Arranged by* C. V. Stanford

A distinctive feature of the illustrations were the highly skilled and sympathetic accompaniments of Mr. S. Liddle.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE HISTORY AND PRACTICE OF THE ART OF PRINTING.

By R. A. Peddie,
Librarian, St. Bride Foundation Typographical Library.

Lecture III.—Delivered December 7th, 1914.

The Nineteenth Century (Part II.) and After.

The development of printing during the second half of the nineteenth century was rapid in the extreme, at least on the mechanical side. Machine succeeded machine, each more rapid and effective than the last. Processes of illustration were born and died, giving place to more rapid and accurate methods. Up to about the year 1890 it cannot be said that a similar advance took place as regards type and type design. If this period showed no development in the printed book, it at least was a period in which the book was produced in a solid manner. In the decent class of book the type was Revived Old Style or Caslon Old Face, the paper was a sound printing paper without any mixture of wood-pulp, china clay, or any of the other abominations of a later period, and the binding cloth was good and strong. The one-volume novel of the sixties or seventies will be found to-day in good order, showing signs of age perhaps, but wearing out, not falling to pieces, as our modern books do after about three people have handled them.

In the late eighties there was a curious epidemic among printers of the use of colour in letterpress work. This was, of course, mostly in job work, but it spread to book work, and there are monstrosities to be found in the way of decorated titlepages in many colours which are calculated to make anyone interested in good printing feel very ill. This curious movement was known, for some obscure reason, as Art Printing. These printers liked to use tint blocks and scroll work and ornamented initials and borders, and all without any idea of the real value or balance of the printed page. The "artist printer" of this period was the man who got most eccentric designs and colours on to the sheet of paper. Luckily for us all, a change was caused by the foundation of the Kelmscott Press by Mr. William Morris. The influence of this Press cannot be overestimated. Morris restored handmade paper, black ink, and good press work to a position that they had lost for many years. The archaic character of his types, which one must admit was carried almost to excess, was one of the most important factors in this revolution. The buyers of modern books, many of whom perhaps had never seen a fifteenth century book, were simply taken off their feet by the magnificence of the Kelmscott Press books. We, of course, know them so well that we take them for granted; but imagine the collector of the editions de luxe of the 1890 period, with their thin type and almost finicking get-up, seeing the "Golden Legend" for the first time. Morris set a fashion of good printing, and even of plain printing, because although the Kelmscott Press books are decorated, they are decorated, as it were, in addition to the printed page. I do not think there is much doubt that Morris would have preferred to illuminate every copy himself, but this being impossible he allowed his designs to be printed at the same time as the letterpress. Morris's designs were personal to himself, and it is perhaps as well that all the ornaments of the Kelmscott Press were withdrawn from use on his death. The type can be used according to his rules, and has been so used with effective results. The types of the Kelmscott Press were three in number. The Golden type, a Roman based on Jensen's letter but with a slight admixture of Gothic style; the Troy type, a round Gothic; and the Chaucer, a smaller Gothic. The Golden type has been copied and modified by many typefounders, and, of course, often spoiled in appearance. The Gothics have not had so much attention paid to them.

The Doves Press was founded by Mr. Emery Walker and Mr. Cobden Sanderson. The type cut for them was a very plain and handsome Roman with a thinner face than that of the Kelmscott Golden type. The style of the Doves Press is one of great restraint. Ornament is unknown, and only here and there is found an initial in red of a striking and effective character.

The type used by Mr. St. John Hornby at his Ashendene Press is based on the Subiaco type of Sweynheym and Pannartz, and is therefore to be described as a semi-Roman. It is effective, and the great Dante of the Ashendene Press is worthy to rank with the Kelmscott Chaucer and the Doves Bible. These three books may be described as the ideal books of modern typography.

The type specially designed by Mr. C. R. Ashbee, for use at the Essex House Press, in printing the King Edward VII. Prayer Book, will be noticed as distinctly different from the

other types mentioned, and it certainly is not so successful. The letters contain too much added ornament. Sufficient reliance is not placed upon plain lettering.

These Presses, to which must be added the Vale Press with a very excellent Roman fount designed by Mr. Ricketts, had a great effect on printing. They created a demand for sound Roman type, and although the printer was only slowly educated up to supplying the demand, and occasionally would make such "bloomers" as to print Caslon Old Face on an art paper, still progress was visible. At times, in fact, the artistic movement went too far. A few years ago there was a passion for posters printed entirely in capitals. This had probably been induced by a study of inscriptions and of the Aldine Poliphilus of 1499. The result was our leading educational authority issued a series of posters containing perhaps forty or fifty lines of solid caps. They looked very nice, but were almost unreadable. Nothing is more dangerous than carrying a cult too far and forcing a process or method to do what it is not adapted for. A face of type may be good for an inscription of four or five lines and impossible in a page of fifty or sixty. All this simply means that theory and practice must work together, and only when they are in strict harmony will the result be really effective.

Typefounders' specimen books of to-day show a great advance from those of the early nineties of the last century. Even in America, where the jobbing types are often of the most eccentric character, the book types were quick to catch the note of the English revival. Morris's types were copied immediately, and in one form or another the new (and old) Romans are to be found throughout the better-class printing of the United States. Germany, of course, followed quickly. Not content with their modified Frakturschrift and the large number of Romans already at their disposal, every typefounder in Germany set out to design and cut new forms of letter. It is practically impossible for type designers to make a decent living in this country, but in Germany it is almost a profession. Goebel's great volumes issued every three or four years show the progress of the art in every department in Germany, and in no section is progress so marked as in that of type design.

Then, again, another great effect of the revival was to draw attention to the correct placing of the type on the page, and to the fact that the opening of two pages of a book is the unit and not the single page. These matters are much better looked after now than they were, and English books have a much better appearance in consequence.

To-day, except for a slight want of originality in type faces, British book printing can bear comparison with that of any country. For book work this country has been almost without a rival for two hundred years. Apart entirely from the private presses I have mentioned, great commercial houses, such as the Chiswick Press, have carried on the tradition of good, solid and artistic work.

There is unfortunately another and a larger section of the printing trade which cannot be said to hold its own in comparison with the work of other countries, and that is ordinary job printing. Prospectuses, advertisements, and other work requiring artistic design and a knowledge of the circumstances of the publication and the resources of the printing office, do not compare favourably with similar work issued in many other countries. A correspondent in Vienna used to send me every year a parcel of ordinary job printing of this kind—good, bad, and indifferent. On looking over the items it was seen that the good prevailed. Similar collections made here do not show the same result. This may be due to the different conditions attaching to technical education. Here, more attention is paid to rapid production and to the teaching of the mechanical art. If artistic training in typographical design is to be had, it is very often divorced from the rest of the course. I would suggest that this is not so in other countries, and that the tremendously rapid advance in artistic typography seen in Germany during the last twenty or thirty years is due to the fact that they have found some method of bringing together theory and practice—of harmonising artistic design with the mechanical trade.

The greatest change in printing is the introduction of typesetting machines. This was one of the great ideals of inventors, and from about 1840 a continuous succession of inventions made their appearance. Generally their exit followed very quickly. The *Family Herald*, a well-known journal to-day, made its first appearance in 1842 in ordinary newspaper folio form with the picture of the composing machine by which it was set up in the head-line. The *Times* was set up by the Kastenbein machine for many years, latterly with new type daily made by the Wicks Rotary Type Caster. The Thorne machine was a considerable success in the

eighties. These machines all took type as it came from the founder. The type was arranged in funnels and fell into place when a key was struck. They generally had a subordinate machine called a distributor to arrange the type in proper order. The invention of the Linotype in 1884–85 brought a new principle into play. Instead of using type, the pressure of a key brings down a matrice of that letter. A line of these matrices automatically justified is carried to the front of the metal pot, where a line of type is cast in solid form from it. During this time the operator is assembling the next line of matrices. When the operation of casting is complete, the slug is automatically shot into a tray and the matrices are taken up by an arm to the back of the machine and hung on a bar. As they are pushed along this bar they fall automatically into their right boxes, and are ready to be used again when required. The solid lines of type or slugs are arranged in a galley, and after correction are ready to be printed from. Most newspapers are set up in this way to-day. After stereos have been made from them the slugs can go back to the metal pot and be used over again.

The Lanston Monotype is on a different principle. It is a type-casting machine casting separate types and actuated by a perforated roll of paper on the Jacquard principle. The keyboard is used for perforating the paper, and the operator at the keyboard has nothing to do with the caster, which may be in another room or another country. In fact, the perforated paper can be sent to America instead of sending stereos, and can be put on a caster there, and the type will be produced in exactly the same manner as if it had gone straight to the caster here. Both machines are actuated by compressed air, and the action of the paper on the caster can be compared to the same kind of perforated paper used on a pianola. The matrix used is a plate of steel about 4 ins. square. On this is found the full alphabet, together with the various sorts necessary. It is actuated by a very wonderful series of levers, which enable it to take position so that any letter or figure may be cast. The work is very rapid, and corrections can be made by substituting single types, whereas in the Linotype the complete line has to be recast. The *Times* is set by Monotype machines, and a great deal of book work is done on them. A new attachment to the keyboard enables the operator to set two editions of a book at the same time, say a 6*s.* novel and the same book in 7*d.* form. The 6*s.* edition can then be set up by the caster and when the time comes for the 7*d.* edition the other roll of paper can be at once put in hand without any further work on the keyboard.

These two machines have revolutionised printing. All our newspapers and cheap books are produced in this manner. For display work and important books, however, hand-setting still holds its own, and although it is dangerous to prophesy, especially in an industry like printing with its rapidity of change, I cannot help thinking (and hoping) that it will continue to be supreme.

Photographic Illustration.

I now turn to the second division of my subject, the development of the processes of illustration

Although what we know to-day as photography, namely, the production of pictures by the agency of light, was brought to a successful issue by 1839, the action of light on a sensitised surface was known long before. Experiments had been made by Wedgwood in England, but he failed to fix the images he produced. Niépce in France was the first to produce a permanent photographic image. He coated metal plates with a varnish of bitumen dissolved in oil of lavender, and when dry he exposed them to the camera, afterwards developing the image by the solvent in which the bitumen had been dissolved, so that he obtained plates with the design in bare metal on a varnish ground. He also exposed his plates under line engravings, and these plates he etched, so that he was able to print from them in a copperplate press. The earliest known example of his work is a portrait of the Cardinal d'Amboise, said to have been printed in 1824. Niépce's process was perfected by his nephew Niépce de St. Victor. The bitumen process first used by Niépce was afterwards developed and extensively used for the production of printing surfaces in intaglio and relief. The next important discovery was that the combination of gelatine and bichromate of potash after exposure to light became more or less insoluble, and therefore impermeable to an etching solution such as perchloride of iron. So by coating a plate of steel or copper with a film of these materials and exposing it to light through a photographic negative, it became possible to etch the plate in proportion to its exposure. This is Fox Talbot's method of photographic engraving of 1852 and 1858, and also forms the basis of modern photogravure introduced by Karl Klic in 1879. This type of

film is also unabsorbent of water in proportion to the action of light, and if placed in cold water after exposure will swell up unevenly and form a relief or mould from which casts can be made in plaster or by electrotyping. This forms the basis of Pretsch's process in 1854, and generally of photo-galvanography or photo-electrotypy. Again, the same type of film exposed to light under a negative, then moistened with water like a lithographic stone, and inked with a roller and printing ink, will only take up the ink in the exposed parts in proportion as the action of light has rendered the film unabsorbent of water. This is Poitevin's process of direct photo-lithography (1855). If the exposed film be inked up without wetting and then placed in warm water, all the unexposed gelatine will dissolve, leaving ink only on the image, which may be transferred to stone or printed from direct, in which latter case it corresponds with Tessié de Mothay's photocollotype (1865).

Parallel with these efforts for the reproduction of tones, there were similar efforts for the reproduction of line work, and, following the discovery of photo-lithography, these were at last successful.

It was discovered by Gillot in 1872 that Fox Talbot's old method of making intaglio plates could be utilised for making relief blocks. The following description will be seen to be almost the same as the earlier method.

A zinc or copper plate sensitised with albumen and potassium bichromate is placed in a printing frame with the negative, and the picture obtained by exposure to light. The plate is then inked and washed, the surplus ink comes away, and the picture remains visible. Asphaltum is then dusted on to the plate, which is then etched to a sufficient depth to give a printing surface. This is one of many methods which differ only in the chemicals used and the elaborations introduced for special work.

Many processes were in use by the seventies and early eighties, but none of them really reproduced all the tones of a picture from the high lights to the deep shadows, and at the same time produced a block which could be printed with letterpress and by the ordinary machine. What was wanted was some method of breaking up the tones of a photograph into lines and dots so that a relief block could be made from it. The early experimenters used screens of crape and similar fabrics, but without much success. Somewhere in the early eighties glass-ruled screens were introduced, which were turned round during the exposure; and finally Mr. F. E. Ives, in the winter of 1885-86, sealed two single-line screens together and made the cross-line screen which is used to-day. This screen varies from 50 lines to 400 lines to the inch. This made the half-tone process possible. The only difference between the actual preparation of the half-tone plate and the line plate previously described is that the negative for the half-tone is taken through the cross-line screen, thereby breaking up the picture into a series of dots.

The latest development of photo-engraving has been in the direction of mechanically printed photogravure. This process, based on Talbot's and Klic's discoveries, is an intaglio method and not relief. A print is made through a screen of transparent thin lines and crossing each other on photogravure carbon tissue. This tissue is laid down on a copper plate for flat printing, or a copper cylinder for rotary work. It is then developed and etched. The lines of the screen being so fine are just sufficient to hold the ink on the cylinder; but when printed the ink runs slightly, with the result that in the deep tones the screen lines are invisible. By the most recent developments it is possible to print, not only the pictures in a magazine or newspaper, but the letterpress as well. This is set up and photographed at the same time as the pictures. It is generally possible in the inscriptions under the prints to see the lines of the screen.

Other Methods of Illustration.

Revival of wood-engraving took place in the sixties; but although great artists drew for the wood and on the wood, the wood-engraver himself did not rise to the occasion, and it was a period of great illustration not always successfully carried out. I will quote what Mr. Gleeson White says in his important work on this period:—

"Soon after this revival wood-engraving as a trade began to feel the photographic competition. By the time the half-tone process was established it was dying, and it was very soon quite dead."

Lithography, on the other hand, has acquired additional strength during the photographic period. The most adaptable of reproductive methods itself, it has adapted photography. As printing machinery developed so lithography developed, and from the hand-press method of the early nineteenth century we see it using the power press in the early fifties, adopting the new metal aluminium as soon as

it was cheap enough, and then using great sheets of it in a rotary machine for printing posters and other large work. Finally, an accident led to the invention of the offset method of printing, which enables lithographs to be printed on any surface of paper. The offset press has a rubber cylinder introduced between the stone or aluminium sheet and the impression cylinder; so that, instead of the hard surface of the stone or plate coming in contact with the paper, the yielding surface of the rubber takes up the design and transfers it to the paper. A much softer impression is obtained with good results. Like all new processes, it was set at once to do work which it was not adapted for, with disastrous results; but as printers have got to know the limits as well as the possibilities of the method, they have succeeded in obtaining better and better results.

Printing Machines.

The third section of this lecture deals with the development in printing machinery from about the middle of the nineteenth century. We have still to deal with the three classes of machines—the platen, the flat-bed cylinder, and the rotary. Although it is not strictly correct chronologically, I propose to take them in that order. The hand press it is unnecessary to deal with, as its history was finished in my last lecture. But the platen machine is a development from the hand press. The platen and the bed are still there, but no longer horizontal, but vertical. The original inventor of this machine was an American, Geo. P. Gordon. The bed is fixed and the platen is forced up to it by steel arms on either side. The platen then returns to its open position, and remains so long enough for the operator to take the printed sheet out with his left hand and lay on another with his right. This press in its various forms is pre-eminently the small jobbing press, although the heavier presses are used considerably for colour work.

The flat-bed cylinder machine began its period of great success soon after 1850. The Main machine, previously referred to, is dated about 1850, and from that time progress has been continuous. Koenig's continuously revolving cylinder of his 1811 machine is now found in the drum-cylinder machines, principally used in America.

The single-revolution or Wharfedale machine, in which the cylinder stops after each revolution to allow of the backward traverse of the bed, came into use about 1860, and has been much improved since then. In the two-revolution machine, of which the Miehle is a type, the cylinder makes two revolutions to each to-and-fro motion of the bed, but during the reverse movement of the bed the cylinder is lifted clear of the type. The two-colour machine enables two colours to be printed on the one sheet before it leaves the press. There are two formes, one at each end of the bed.

The final section of flat-bed cylinder machines is that of Perfecters. These machines print single sheets on both sides during their traverse from the feed-board to the delivery-board. They have two large cylinders instead of one. This type of machine is gradually dying out, being attacked by the fast Wharfedale machine on the one hand and by the rotaries on the other. Of late years the addition of automatic paper-feeders, mostly pneumatic in action, has quickened up the action of printing machines using flat sheets.

Turning to Rotary machines, I carried their history up to the introduction of the Walter machine into the *Times* office in 1868. This was the first machine to print on the roll of paper, from curved stereos, to perfect the sheet and produce a complete newspaper. These machines were used by the *Times* until 1895. Folding mechanism had been attached to them about 1885.

The development of the newspaper machine during the twenty years following the introduction of the Walter Press was slow. Single-roll machines were the rule rather than the exception, and the increasing circulation was met by putting in fresh machines. The newspapers during the period 1870–90 were only four to eight pages, and this was the limit of the machines then used. The competition, however, added to the cheapness of paper, resulted in an enlargement to twelve pages. Such enlarged issues could not be printed on one machine. The extra pages had to be added by hand. This resulted in the construction of machines that would produce newspapers of a varying number of pages, from four to twelve or sixteen, all inset, cut at the head, and folded in a more convenient form. It was found to be impracticable to produce these different sizes from a single web of paper; therefore several printing presses* were

* In England the distinction between the words press and machine is definite. Press is only applied to the hand press and the platen. All others are machines. In America the word press is applied to all. I have been somewhat indiscriminate in my use of the words, inclining more perhaps to the American than to the English use.

combined in one machine, each printing from a separate roll or web of paper and all conveying the printed sheets to the same folder, where they were incorporated in the one newspaper. Such is the multiple web machine of to-day. A classification of these combined machines may be made as follows :—

1. Two presses at right angles to one another and forming one machine. These are known as supplement or quadruple presses.

2. Two or more presses working one above the other with connection between each. These are known as two-decker and three-decker machines.

3. Two or more presses one behind another and capable of being coupled together to form a combined machine. This is called the tandem system.

4. Two presses arranged with a space between them where the folding mechanism is placed.

It may be said that there is no standard pattern of newspaper printing machines. The conditions in each office vary so greatly as regards space, both in area and shape, that each case is treated on its merits and special designs are made.

We now resume the history of the newspaper printing machine where we left it at the introduction of the Walter Press into the *Times* office in 1868. The Marinoni machine was introduced in Paris in 1868 for the purpose of coping with the increasing circulation of *Le Petit Journal.* This was not a web printing machine, but was the last and most rapid of the sheet-fed newspaper machines. Two of the machines were bought for the *Echo,* and that paper was printed by them early in 1872. About 1874 Mr. Edward Lloyd introduced the first open-delivery Hoe machine, which printed from the web. Hoe rotaries had been used for some time previous to this date in America. The Hoe Double Supplement Press was introduced about 1887, and eight machines were installed to print *Lloyd's Weekly Newspaper.* This machine turned out four, six, eight, ten, and twelve-page papers at 24,000 per hour, and sixteen-page papers at 12,000 per hour, the odd pages being in every case accurately inserted and pasted in, and the papers cut at the top and delivered folded. This machine is of the right-angled variety mentioned above, and prints from two rolls, the one on the long side being twice the width of the other, which is only one page wide. In 1895 these were superseded by Hoe's three-roll presses, using single-width webs. These machines had three reels of paper at one end, and the supplement press at right angles was rendered unnecessary.

In the same year, 1895, the *Times* replaced the Walter presses by Hoe's three-roll machines.

Lloyd's three-roll single machines were replaced in 1901 by the three double-width roll or sextuple type. These produced double the output of the single machines and necessitated the use of two folders instead of one. In 1902 the order was given by Messrs. Lloyd to Messrs. Hoe for the first of the present battery of seven double octuple machines. These machines, which now print *Lloyd's Weekly Newspaper,* are the most powerful newspaper printing machines at work in this country at the present moment. They take four double-width reels of paper at each end, are four decks high, and are constructed in such a manner that another deck still can, if necessary, be added at the top. The capacity of each of these machines is 144,000 per hour, up to sixteen pages ; from eighteen to thirty-two pages, 72,000 per hour, and so on in proportion. The papers are delivered folded and automatically counted.

The latest improvement in newspaper printing machinery is the making of the stereotype plates by machinery. After the flong—that is, the paper matrix—has been made by pressing it on to the type, it is placed in the casting-box of the autoplate, and as many plates as are necessary are cast from it. They are trimmed automatically and are ready to go on to the press.

Rotary machines are also used for the big runs of popular journals, and if the journal has a coloured cover this is printed on a smaller rotary at right angles. The body of the paper and the cover are brought together at the folding mechanism, and the complete paper stitched in its cover is counted out in quires.

So we have seen in the last hundred years the development of the art we saw emerge from obscurity some 450 years ago. All the speed and wonderful power of production we have seen it gather is unfortunately not all gain. Worse printing can be and is done to-day than ever has been done ; but at the same time there appears to be some light in the darkness, some indication that the printer is taking more interest in his craft and is beginning to realise more of its possibilities. The good effects of the work of William Morris and Emery Walker are distinctly visible, and there is hope for the artistic future of the "Art preservative of all Arts."

THE PRODUCTION OF FINE SEA ISLAND COTTON IN THE WEST INDIES, WITH PARTICULAR REFERENCE TO THE ST. VINCENT INDUSTRY.*

At least 130 years ago a fine cotton, presumably Sea Island, was grown in the West Indies. Seed was sent to the United States, where, it is stated, a stock was gradually matured with an annual habit directly adapted to the climatic conditions of a limited tract of country. This special stock, according to Sir George Watt, embraces all the finest grades and most valuable cottons of the world, and is in fact true Sea Island, now known botanically as *Gossypium barbadense* var. *maritima*, Watt.

The cultivation of long-stapled cotton was never completely abandoned in the British West Indies, but was confined after the American Civil War to a small production in the Grenadines. The revival of fine Sea Island cotton-growing, however, dates from the year 1901, when small experimental plantings were made in this and the following year from seed obtained from the United States. The results were so promising that Sir Daniel Morris, then Imperial Commissioner of Agriculture for the West Indies, and Mr. J. R. Bovell, Superintendent of Agriculture, Barbados, paid a special visit to the Sea Island cotton districts of South Carolina and Georgia in 1903. The valuable first-hand information which these gentlemen obtained was of much value to West Indian planters. Besides, during his visit Sir Daniel Morris obtained a large supply of seed of the fine River's type, produced on the seaboard of South Carolina. This variety is still largely grown, as are also other fine varieties obtained through the British Cotton Growing Association and others. In the year 1905 the American growers of the finest Sea Island cotton combined to prohibit the exportation of seed; but this action had little or no effect on the West Indian industry, for it was proved by this time that with careful local selection and cultivation the quality of the cotton could be maintained and in many instances improved, with the result that to-day the finest cotton in the world is produced in certain of the islands.

The chief British islands exporting Sea Island cotton are St. Vincent, St. Kitts, Barbados, and Montserrat, but the industry is successfully carried on in several of the others. St. Vincent, besides being the premier cotton-growing island, also produces the most valuable cotton. In St. Kitts, however, where the soil and climatic conditions are somewhat similar to those of St. Vincent, some exceptionally fine cotton is grown. In the paper now submitted it is proposed to refer more particularly to the St. Vincent industry, because—

(*a*) The British Cotton Growing Association advises West Indian planters to cultivate for fineness of lint in view of the competition of certain Egyptian and American cottons with some of the cotton produced in the West Indies, but not with that of St. Vincent;

(*b*) The methods adopted in the production of cotton in St. Vincent and the measures taken for the protection of the industry have been under closer governmental control than in any other island; and

(*c*) The highest degree of success has been obtained in the production of fine cotton.

The soil of St. Vincent is of volcanic origin throughout, and may be classed as a dark sandy loam. With the exception of St. Kitts, the soils of other islands are, as a rule, heavier in character. The rainfall of St. Vincent is ample and often excessive, and exceeds that of the other Colonies.

Mention has been made of the introduction of the River's and other fine types from South Carolina, and it is from these that the successful local industry has been built up. Great care had to be exercised at the outset to ensure that only seed from the best fields of plants true to type was planted. The seed now used for planting is all obtained from nurseries or selected crop lots, and is tested, selected, and sterilised before being sown. The seed selected must be heavy and sound with a tuft of green fuzz at one or both ends. Arrangements are made with planters by the Agricultural Department to grow special fields from seed from selected plants at the experiment station in order to keep up the standard of cotton grown by small growers. Most of the large estates now maintain their own nurseries. The methods adopted in plant selection are based on desirable field characters of the plant, yield of seed-cotton, length, fineness, strength, uniformity, and lustre of the lint. Plant selection for resistance to certain bacterial and fungus diseases is also largely carried out and with promising results.

The work of maintaining the quality and yield of cotton in St. Vincent has been greatly facilitated by the enacting of certain legislative measures. Under the ordinance for the prevention of the introduction of pests and diseases power is given the Agricultural Authority to destroy, fumigate, or sterilise all seed-cotton or cotton seed brought into the Colony, and the provisions of the ordinance are strictly enforced. Under the Agricultural Products Protection Ordinance all sales of seed-cotton of a less amount than 100 lbs. in weight have to be made to the Government Central Ginnery, but lots up to 4,000 may be sold. The object of the action thus taken was to prevent cotton stealing, but as the Government wisely purchases the cotton on a profit-sharing basis there are few sales to licensed dealers. At the present time there is only one licensed dealer in the Colony, and the licence is held by a responsible firm who do not sell seed for planting purposes to the peasantry. As a result the seed supply is under close control.

* Abstract of a paper read by W. N. Sands, F.L.S., Agricultural Superintendent, St. Vincent, at the Third International Congress of Tropical Agriculture, London, 1914.

A third ordinance which has an important bearing on the industry is that providing for the destruction of all cotton plants at the end of each season in order to prevent the carrying over from one season to another of certain posts and diseases. As the provisions of this measure cover all kinds of cotton, whether wild or cultivated, it has been possible to destroy all the perennial wild or semi-wild types and so reduce to a minimum the danger of cross fertilisation of the valuable Sea Island variety with undesirable kinds.

The methods of cultivation, yields per acre, details of picking, bulking, drying, ginning, and baling are fully described in the paper, together with the chief characteristics of the lint and the uses to which it is put.

The prices obtained for St. Vincent Sea Island white cotton during the past three seasons have ranged from 2*s.* to 2*s.* 9*d.* per lb. for the "superfine" and from 1*s.* 6*d.* to 1*s.* 11*d.* for the "ordinary."

The industry is a remunerative one in an average of years.

THE FUTURE OF INDIGO.*

By Professor Henry E. Armstrong.

Under the title "The Downfall of Natural Indigo," a long letter from my pen was printed in the London *Times* of April 15th, 1901, in which the story of synthetic indigo was told at length. This may also be read in my book on "The Teaching of Scientific Method," published by Messrs. Macmillan & Co. I have followed the development of the industry in the interval. Recently, during my short stay in India, I have endeavoured, especially when visiting the Agricultural Research Institute at Pusa, to learn as much as possible of the state of the Indian grower.

With reference to the article in *The Statesman* of November 14th, on the "Indigo Trade Revival," may I say at once that Mr. Bridgett displays the usual prejudice in asserting that natural indigo "makes the very best and fastest dyes, whereas the German chemical substitute gives a dull, dead colour which often washes out." It is nonsense to talk of the real indigo "having the natural energy put into the plant by the sun"—the natural and the artificial article are one and the same chemical substance. If the natural article be so superior, why has the industry languished? I should advise Government to do nothing until they have a guarantee that the planters will bestir themselves. Our foolish if not criminal policy of allowing the Indian industry to be supplanted is the result of indifference, if not of ignorance and of the inability of those concerned to take combined action in placing it on a scientific footing. I have recently had the opportunity of inspecting the Government quinine factory and cinchona plantations near Darjeeling, and have seen what scientific acumen has done to place this industry on a satisfactory footing. Not so long ago it was more or less a failure, I understand. There is little doubt that if real intelligence had been directed to the indigo problem, that also would have been solved, though I am free to confess that the task is a difficult one. Thirteen years ago, in the letter referred to, I wrote: "Of one thing we may be certain, that if indigo planters desire to retain any share of the industry, they must not only seek to improve the methods of cultivation and of extracting the dye-stuff, but they must be prepared to refine the natural product and supply a practically pure article. Even in indigo dyeing the days of the rank empiricist are numbered, and the certainty which attends the use of pure materials in fairly skilled hands will have its inevitable influence." This has proved to be the case. The preparation of the indigo-vat, in days gone by, was a difficult matter, in the hands of a few skilful people, but these were empiricists. Since synthetic indigo came into the market dyers have been supplied with a paste containing a fixed, known proportion of the dye-stuff, not an ever-varying proportion, as is the case when the natural product is used. Improved methods of preparing the dye-bath have been introduced, and the operations of the dyer greatly simplified. In the case both of artificial madder and of artificial indigo, however, the natural dye-stuffs have been ousted not merely through the production of the substitutes at cheaper rates, but more particularly through the introduction of articles of standard strength, and the consequent simplification of the dyer's work. If the advantage gained by natural indigo through the war is to be maintained, I believe it will be necessary for planters in future in some way to arrange to bulk their products and put upon the market a paste of fixed composition comparable with that supplied by the Germans.

I cannot help thinking that it should still be possible to secure a fair share of the trade for natural indigo in competition with the synthetic article. The possibilities in the way of effecting improvements, especially in agricultural practice, in the plant itself and in the process of manufacture seem to be in no wise exhausted. Our understanding of such matters is now so much greater than it was even ten years ago. Various inquirers have studied this or that side of the problem, but apparently no attempt has been made to deal with the subject comprehensively from the many points of view from which it must be regarded if success is to be assured. The men who have been engaged have not had the all-round knowledge or the ripened ability as investigators that is required to deal with the many issues, scientific and economic, that are involved. It cannot be insisted too strongly, in fact, that the problem is one requiring very special knowledge

* This article, reprinted from *The Statesman*, of Calcutta, of November 17th, 1914, was written by Professor Armstrong in reply to another on the "Indigo Trade Revival."

and acumen. But it is nothing short of a disgrace to us that such an industry should be allowed to lapse in a country where the need of native industries is so great. The recovery of the position of natural indigo may be a costly business, but if one-tenth of the zeal put by the Germans into the production of the artificial pigment be brought to bear on the problem, I believe it will be solved satisfactorily.

LABOUR CONDITIONS IN NAPLES IN 1913.

During 1913 Italy generally, and especially the consular district of Naples, was characterised by a tendency towards over-industrialisation, which, as in many other countries, has had regrettable results. The land has been neglected in favour of industry, and emigration has powerfully exercised its allurement of better wages for women as well as men. The flower of the population is continually flowing out of the country, and the land thus remains to be tended by an agricultural population of a lower standard. If greater attention were paid to the land and its capabilities under up-to-date culture the attractions of emigration might be greatly diminished. In some localities, too, re-afforestation would yield considerable advantages. But of course the prime necessity is money and, following on that, more elastic fiscal regulations. Just at present the *mot d'ordre* is rigid economy in State expenditure, and with regard to the latter the conditions are difficult, as the collectors of taxes being remunerated by a *pro rata* commission, their obvious aim is to extract all that is obtainable from the taxpayers.

One of the most vital questions which affects life at Naples is that of an adequate water supply, for drinking as well as for street watering and flushing, and from various causes there is a tendency to waste during the summer months, which makes the problem of street watering, with economy of the drinking supply, a question of considerable complication and difficulty. Many authorities besides the Socialist members of the Town Council advocate the municipilisation of the gas, water, and electric lighting undertakings, all of which, with the exception of the last named, are in the hands of foreign companies.

With regard to the housing of the working classes in Naples, there is still a great deficiency of accommodation, insomuch that the dwellings are drawn for by lot. Moreover, the rent of the rooms is found to be very high, which, with the cost of locomotion from the dwellings to the business centres, makes the total rent charge prohibitive. During 1913 labour at Naples asserted itself by striking for improvements, but sometimes these were on grounds apparently inadequate to justify the throwing into enforced idleness of large bodies of workmen dependent on daily earnings for a living and the consequent paralysing of public life. Recent strikes have, however, developed in the ordinary peace-loving Neapolitan a strong sense of rebellion against allowing the public services to be at the mercy of labour agitators. The teachings of these demagogues have driven, in some cases, employers to seek means of carrying on industries with a minimum of hired labour. Labour-saving machinery is thus displacing hand labour, which cannot always be relied upon. The installation of machinery in some cases has opened the eyes of the industrialist to the fact that he is now turning out a better product at a higher profit to himself, whilst paying his much reduced staff better salaries.

THE ENCOURAGEMENT OF CHINESE NATIVE TRADES IN SHENSI.

Shensi, one of the eighteen provinces of China proper, occupies an area of about 75,270 square miles in the north-western part of the country. It supports an estimated population of 8,500,000, of which number the greater part live in the south-eastern portion of the province, where are practically all of the important cities, including Sianfu, the capital. Owing to its geographical isolation, Shensi remains one of the least known provinces of China proper. Three purely native trades are taught at Shensi—weaving cotton rugs in the native fashion, weaving woollen Tientsin rugs, and making lacquer ware. Native cotton rugs are woven in a curious fashion. No loom is used, the warp being raised from the floor by brackets some thirty feet apart, between which it is stretched at a distance of a few inches above the ground. The rugs are woven in sections one foot wide and six feet long, five of such sections being woven in one piece. According to the United States Consul at Dalny, the operator squats across the warp, with the finished portion of the strip behind him, and moves a small stand, which separates the strands of the warp, along in front of him as he works.

The shuttle is thrown by hand from side to side. For the warp foreign imported thread is used, while for the woof native thread is found to be sufficiently good. A pattern is woven in, the right and left hand and middle sections being woven at different times, but with such a degree of accuracy that the figure of the pattern matches perfectly when the rug is assembled, which is accomplished by sewing together the four appropriate sections, making a rug six by four feet, closely woven and about the weight of a piece of heavy canvas.

All sorts of articles, from small pin boxes to heavy furniture, are manufactured in lacquer. For small articles a base of leather is used; this is wet, placed on a last of the desired shape, and pounded and ironed until it takes the shape of the mould and its edges adhere one to the other. The receptacle so formed is roughly coated with lacquer inside and out, further coats being added until the necessary degree of stiffness is secured. It is then hand-polished with wet charcoal until smooth, when the fine upper coats are applied. The number

of these depends on the quality and ornamentation desired, articles carved in heavy relief requiring many more coats than those bearing a plain polished surface. For the larger articles, such as furniture, trunks, etc., a wooden base is used. At the Provincial Industrial Exhibition held in Shensi, in celebration of the second anniversary of the Republic, a great variety of lacquer was on view, including a pair of very handsome Chinese wardrobes with panelled doors. These measured about six feet in height by five in breadth by one foot and a quarter in depth.

The third of the purely Chinese trades taught is the weaving of Tientsin rugs or carpets. The warp and woof of these are heavy cotton thread, generally of foreign origin, and the pile either camel's hair or wool. The warp is stretched vertically from a fixed support on the top over a roller at the bottom. The woof and the pile are put in by hand. Several workmen are engaged on the same rug at the same time, as each man can handle but five feet in width on the rug. The pile is applied by knotting woollen yarn loosely about the warp; the ends of the yarn are then cut roughly with a knife. The woof is next woven in about the last line of pile, and hammered down with a small wooden mallet. The pile is now trimmed to the desired length with shears, and the process repeated for each line of pile. When several feet of the rug have been completed, the finished portion is taken up over the roller at the bottom, the warp being adjusted at the same time on the fixed support above. Rugs are woven at the rate of a foot a day, the number of workmen on each rug depending on its width, as explained above. Most intricate patterns are woven with no guide for the workmen beyond their memories. The price of a rug depends on its quality, which is judged by the material employed and the number of strands of woof to the inch.

The above trades are taught in the Industrial Training Institute. There are in the institute about two hundred students, all drawn from the poorer classes, learning seven different trades. Apart from the master workmen, who are the actual instructors, there is a staff of fifteen directors and supervisors. The majority of the students are engaged in learning some form of the cotton spinning or weaving industry. The spinning is done on small foot-power machines, built locally in wood after the pattern of imported iron machines, each machine having twenty spindles. There are seven of these machines in use, each capable of spinning about three pounds of cotton per day. In the cloth and towel weaving industry there are about fifty students. As with the spinning machinery, the hand looms are copies in wood of foreign iron machines. The thread used is partly imported and partly of local origin. Turkish towels, very commonly coloured either pink or blue, and both coloured and figured cloth are woven. To this end a considerable part of the institute is given up to dyeing thread. The students in the institute receive no pay, but are given board and lodging. No apprenticeship fee is asked, as the intention is to draw the students from the poorer classes. The course is of three years, at the end of which time those who have qualified are in a position to earn from 12*s.* 6*d.* to 21*s.* per month, which is considered good pay in Shensi. Some of the students are retained at the institute as instructors, others secure positions as instructors in similar institutions in other parts of the province, while the majority are expected to find work with the general public.

ENGINEERING NOTES.

Sydney Harbour Bridge and Connecting Railways.—The great expansion of the trade of New South Wales and the fact that Sydney has already become the fifth port of the Empire have made it necessary to provide new facilities for its interna and suburban traffic. In fact, it is asserted that the streets of Sydney are more congested than those of London, where tube, motor-bus, and tramway development have kept pace with the requirements. In Sydney the main problem will be to link the north and south side of the harbour. The scheme which is to be brought before the New South Wales Parliament involves the construction of underground railways in the city itself, the electrification of the suburban lines, and the building of a large high-level bridge to connect the north and south side of the harbour. The city of Sydney is situated on the south side of the magnificent bay, and populous suburbs have risen on the north shore. The outlay for the whole project, comprising the erection of a large electric power station, is estimated at £17,000,000. In order not to obstruct the shipping, which aggregates more than 20,000 vessels annually, the bridge will have to cross on one clear span of 1,600 feet. By adopting gradients at each end of the bridge, a junction of the bridge railway with the underground system could be effected, and at the same time give the bridge a headway of 170 ft. at high water. This would clear the masts of all ships trading with Sydney. The rocky shore favours the construction of the bridge, and the Public Works Committee have decided on the cantilever type as being the most rigid and suitable for heavy traffic. Nickel steel is to be the chief material. The anchor arms are to be constructed on false-work and the cantilever arms are then to be erected, the suspended span being also built from both sides by the cantilever method. The greatest wind velocity recorded at Sydney was 120 miles per hour, and consequently a wind pressure of 50 lbs. per square inch is to be allowed for.

Remarkable Ferro-concrete Tunnel in America.—A most unusual piece of engineering construction is nearing completion at Baltimore. The work consists essentially of converting an old brick-lined water tunnel, in which the flow was by

gravity, into a pressure conduit operating under a head of 35 lbs. per square inch. The novelty lies in the use of huge separately moulded concrete pipes, the largest having a diameter of 9 ft., to form the new tunnel lining. As the existing tunnel is only 12 ft. in diameter, it is clear that the work had to be carried on in cramped quarters, and, in addition to the difficulties inherent in placing 10½-ton sections of pipe with so little working room, there is the obligation of shutting-down operations every few days and using the conduit to deliver water to the city. The valves are then closed and the tunnel drained in order to allow the work of lining to proceed. One of the features of the construction is a specially designed car, which carries the ponderous pipes into the tunnel and by means of adjusting equipment sends them accurately to line and grade. The concrete pipes are of particular interest, for they are claimed to rank amongst the largest precast units ever built. It is also unusual to use ferro-concrete to resist such a great internal pressure as is found in the Baltimore tunnel conduit.

Electric Canal Haulage.—The Harecastle Canal tunnel, constructed by Telford in 1827, has been worked by horse haulage until recently, when, owing to mining subsidences, the towing-path became inundated. The adoption of electric haulage presented some engineering difficulties, as, in consequence of the lowness of the tunnel roof, an overhead trolley wire could not be used. The North Staffordshire Railway Company have carried out a scheme in which a cable of four steel ropes has been laid through the tunnel, with an anchorage at each end, and the haulage boat is attached to this cable. The current cannot be conveyed direct from a generating station to the haulage boat, and the necessary supply of electricity is derived from accumulators carried in a special barge linked up with the hauling boat. The power is generated at a special station which has been erected at the Chatterley end of the tunnel. Each accumulator barge carries sufficient energy for several journeys, and whilst one is in service the accumulators of the other are filled at the generating station. The haulage barge is capable of pulling along seventeen loaded barges, each carrying twenty tons, and of accomplishing the journey through the tunnel in forty minutes.

The New System of Electro-percussive Welding.—This process adds another to those electric welding methods already existing. Arc welding has been very successful, and is effected by the intense heat of a direct-current arc with the aid of a suitable flux. Another method consists in passing a very heavy current through the metal pieces until the intense heat causes them to weld together. Alternating current is employed in this system, being more conveniently transformed to the very low voltage required. The new method is described in a paper by Messrs. C. E. Skinner and L. W. Chubb, presented at a recent meeting of the American Electro-Chemical Society. The paper states that in the process of electro-percussive welding two wires are welded together by causing a condenser discharge to pass between the ends of the wires at the moment when they are pressed together by mechanical force. The generation of the heat is so localised, so sudden, so intense, that there is no time for unequal heat conduction through the shanks of the wire, and the ends will be melted and even vaporised whether the melting-point is high or low. For this reason metals of different kinds can be welded together independently of their electrical resistance, melting-point or heat conductance. Any combination of metals which has ever been tried will weld together, but the joints will not be permanent with such combinations as aluminium and tin, or lead and iron. Electrically the weld is complete in 0·0012 second, and although 23 kilowatts are being dissipated between the ends of the wire at a certain instant the total energy used at the weld is about 0·00000123 kilowatt-hour, or enough to light an ordinary 50-watt 16 candle-power lamp for 0·09 second.

A Two-thousand Ton Forging Press.—Illustrations and notes in the *Engineer* describe a very ingeniously-designed hydraulic press which has recently been built by Davy Bros., Ltd., of Sheffield. This machine is to be used for slabbing and punching steel tyres with the minimum manual labour, which is its notable feature. With this object in view the machine is provided with an electric rotating gear, hydraulic sliding mechanism, and apparatus for mechanically manipulating the blanks or blooms throughout the entire process of slabbing and punching. The revolving anvil, operated by an electric motor, is mounted on a sliding-table which is caused to move backwards or forwards on a machined slide on the bed by hydraulic power. This arrangement enables the blank to be withdrawn clear of the press to facilitate the handling of the work, and allows it to be lifted direct by the crane without having to pass it between the upright columns of the press. The arrangement is such that the rotating and sliding motions can be carried out simultaneously. To avoid frequently starting and stopping the electric motor it is run continuously, a slipping clutch allowing the table to stop when the forging is under the grip of the press, the rotation continuing directly the pressure is removed, a large amount of time also being saved in this way. With the exception of the rotating gear, all other movements are made by hydraulic power. When punching, the hole is partly made from the top and then the punching of the hole is completed in an upward direction, thus avoiding the formation of a fin. Beyond bringing and taking the blooms away, the whole sequence of operations is carried out under the press without any manual labour whatever.

An All-metal Diving Dress.—After experiments extending over five years the metal diving dress for deep-water diving has now reached a practical stage, and, it is claimed, will warrant its employment for a difficult job of off-shore salvage in waters too deep and too exposed for the use of the ordinary diving outfit. The *Engineer* in describing this invention states that in principle it is not strictly a novelty, because others have worked towards the same solution of a deep-diving apparatus; but this American dress is said to be the most feasible and efficient of these various efforts. During some demonstrations divers have used this armour at a maximum depth of 212 ft., but could have gone deeper had more water been available, and these submergences have proved extremely suggestive when viewed in the light of the circumstances under which they were made. The limitations peculiar to the elastic diving dress are directly overcome by the all-metal dress. The suit consists of a series of articulated sections having sliding or rotating joints, and these are sealed sufficiently by means of leather and rubber packing so that they may be either entirely water-tight or nearly so. There are fifty-six of these flexible joints. Mr. Chester Macduffee, the inventor of the dress in question, has designed his suit so that it is strong enough to withstand the crushing force of the sea without having recourse to air pressure within. The success achieved depends partly on the use of a suitable aluminium alloy. The diver breathes air at atmospheric pressure no matter how deep he goes. A hand-lamp is attached to the end of the left sleeve and may be supplanted by a hook. The right sleeve terminates in a mechanical hand composed of twelve steel fingers which are actuated by a sliding rod drawn inward through a stuffing-box by the simple act of gripping on the part of the diver. This new apparatus opens the way for certain salvage operations and deep-water explorations which otherwise would be out of the question, as the weather conditions and the tidal circumstances which hamper so much the man in the elastic dress would not place the same hindrances in the way of the diver clothed in the rigid outfit.

CORRESPONDENCE.

THE INDIAN INDIGO INDUSTRY.

Margin for an Improved Process of Manufacture.

I have noted with great interest Dr. Mollwo Perkin's views as to the probable loss of 50 per cent. of the dye during manufacture as against the estimated 15 per cent. which we were led to believe takes place. This higher estimate, to my mind, makes all the difference when considering the advisability of further research work with a view to the possible development of a scientific method of extracting the dye, as indeed has been recently successfully accomplished in the case of the extraction of quinine from cinchona bark, an industry worked in Bengal by the Government of India.

In my opinion, an alternative method of extracting the dye is most necessary, and should conform to Professor Meldola's scientific suggestion put forward in his paper published in *Nature*, July, 1908; and I believe if a process could be devised in which all the leaves under treatment were simultaneously, uniformly, rapidly, and fully extracted, a much higher yield and a purer product would be obtained.

At present, under our actual working conditions, I think the degradation of the plant-extract is far more rapid and extensive than is estimated by the results of laboratory experiments, and consequently the loss mentioned by Dr. Perkin may even be exceeded.

If very rapid, complete, and uniform extraction could be obtained, I hold the view that this heavy loss would, in part at any rate, be avoided, and to make the advisability (in my opinion) of further research work clear, I will put the probable loss, as given by the author, into sterling values.

An average Behar indigo concern used to turn out about 1,000 maunds of indigo in an average season, the gross value of which, at 4s. per lb., amounts to £14,500, and if the outturn was only 50 per cent. of the possible, it is evident that a loss of £14,500 was taking place! This would seem to justify a further effort being made to put the industry in a position to compete with its artificial rivals in future.

Future Competition.

I note the remarks made with regard to this point in the discussion, and it seems to me that it remains to be seen at what cost synthetic indigotin, aniline and alizarine dyes can be produced at and sold here, and also in Germany, after the war. The Germans never disclosed their costs of production of synthetic indigotin, and the firms interested may have been losing in this department of their enormous businesses, hoping to recoup themselves by a world's monopoly later on.

It seems to me that in the past—1897 to October, 1913—they had the benefit of a very cheap supply of commercial benzol, from which aniline is produced, and which is, therefore, the raw material in one of the processes for the manufacture of synthetic indigo.

This period of cheap benzol appears to have ended about the above date owing to the rapid advance in the price of petrol—benzol as a substitute increasing in price—and it seems to me that the price of the latter is not likely to fall, especially when Britain and Germany come into future competition for it for motor fuel and the raw material of their artificial dyes. If I am right in this view, it would seem as if natural indigo might possibly benefit.

Dye Vat Tests.

I would like to mention that no authoritative tests to ascertain the real dyeing values of indigo and synthetic indigotin have ever taken place, and

I hope prominence will be given to this fact, and that proper trials will be made to decide once and for all their actual dyeing strengths, and consequently the real values, of these two rival dyes.

LEWIS J. E. HAY.

42, Frederick Street,
Edinburgh.

OBITUARY.

CHARLES EDWARD CHRIMES.—Mr. Charles Edward Chrimes, who died on November 28th last at the age of seventy-five, was the surviving principal of the firm of Guest & Chrimes, foundry and general brass works, Rotherham. For over sixty years he had been associated with the firm of which he eventually became the head, and it was generally due to his efforts that the house of Messrs. Guest & Chrimes attained its present reputation.

He was naturally of a retiring disposition, taking no active part in public matters, and what services he rendered in this direction were given in a quiet way, as were his benefactions to local institutions, which were considerable. The greater part of his time was devoted to business and care for his workers, the fact that so many men having been employed by the firm during the whole of their working career being a testimonial to his management, kindness, and generosity.

Mr. Chrimes was elected a member of the Royal Society of Arts in 1897.

NOTES ON BOOKS.

RAILWAY RATES AND TRAFFIC. Translated from C. Colson's "Transports et Tarifs." By Charles Travis. London: G. Bell and Sons. 3s. 6*d*. net.

The authors, for Messrs. Christie and Leedam were associated with Mr. Travis in the work of translation, have selected from a well-known French authority those portions of his book which they consider most suitable for English readers, and it may be assumed that their method was judicious, though Mr. W. M. Acworth, who contributes a brief introduction, regrets that it was not found practicable to translate the whole book as it stands. The French, after their wont, have dealt with the whole question of transportations, tariffs cost, and administration, in a more logical and scientific manner than we have ever attempted, and though M. Colson has naturally treated his subject as applied to French methods, the general principles are applicable to all countries. The book is, therefore, one that can be commended to all students of railway economics, and indeed to all students of economics. It is divided into four parts. Part I. deals with the economic considerations which determine the cost of transportation; Part II. with railway rates in France; Part III. with rates in Europe and America; while Part IV. is devoted to the author's general conclusions.

GENERAL NOTES.

CHADWICK PUBLIC LECTURES.—A course of three lectures (illustrated by lantern-slides) on "War and Disease" (1. Continental Wars of the Nineteenth Century; 2. The South African and Russo-Japanese Campaigns; 3. The Great European War), by F. M. Sandwith, Esq., M.D., F.R.C.P., Gresham Professor of Physic; Senior Physician, Albert Dock Hospital, and London School of Tropical Medicine; Chairman of the County of London Branch of the British Red Cross Society; formerly Senior Physician, Imperial Yeomanry Hospital, South African Field Force, will be delivered on Fridays, January 15th, 22nd, and 29th, 1915, at 5.15 p.m., at the Royal Society of Arts, John Street, Adelphi, W.C. The chair will be taken on January 15th by Sir William J. Collins, K.C.V.O., M.D., M.S., B.Sc., Chairman of the Chadwick Trustees; January 22nd by Sir Frederick Treves, Bart., G.C.V.O., C.B., F.R.C.S.; January 29th by Sir Henry Trueman Wood, M.A.

THE ANNUAL OF ART WORK.—The first number of this annual, which is a supplement to the *Art Workers' Quarterly*, has just been issued under the editorship of Mr. W. G. Paulson Townsend. It contains, among other things, articles on the Relation between Trade and Art, by Mr. Frank Stuart Murray; the English Home, by Mr. C. F. A. Voysey; Water-Colour Hand-Prints, by Mr. W. Giles; Technical Education and Industrial Art, by Mr. Arthur Wilcock; and an excellent article by the late Mr. Lewis F. Day, on the Designer and his Trade, which was originally written for members of the Design Club. Although the subjects dealt with are naturally very various, throughout the whole annual one theme is generally insisted upon—the dependence of our industries upon artistic qualities for their success. The annual is well printed on good stout paper, and the numerous illustrations are admirably reproduced.

INDIAN, CEYLON, AND JAVA TEA IN 1914.—The most remarkable feature of the tea market during the year just ended was the sustained demand in spite of the outbreak of war and its attendant disturbing influences. The year opened with a very strong position, duty payments for 1913 having increased by some 10,000,000 lbs. over 1912, and consumption per head of population having advanced from 6·46 lbs. to 6·61 lbs. A very satisfactory level of price has been maintained throughout 1914, especially for useful common and lower medium sorts; any considerable decline, such as that which occurred towards the end of September, being only of short duration. During the latter half of the year, the outbreak of war in Europe and the interference with shipments both from India and Ceylon made market conditions entirely abnormal; an extensive demand from near continental countries (combined with smaller offerings at a period when the trade is usually fully supplied)

resulted in a very considerable rise in prices, especially for leaf descriptions, and during the first week of November clean common leaf touched the high level of 9¼*d*., a figure not reached since June, 1891. The stringent regulations as to exports to Holland, Norway, Sweden, and Denmark, made on November 17th, at once caused a sharp reaction; prices gave way for some of the better leaf kinds as much as 1*d*. to 1½*d*. per lb. within a week, whilst the increase of the duty from 5*d*. to 8*d*. also brought about a quieter demand for finer and tippy descriptions; on the whole the market has been in favour of producers, and the prices realised by the majority of them can be considered as quite satisfactory. Imports of all tea to the United Kingdom for the year were smaller, being 344,750,000 lbs., against 366,023,125 lbs. in 1913, whilst deliveries both for the home trade and exports were considerably larger, and stocks at December 31st show a large decrease. Therefore, from a statistical point of view, the position at the moment is very encouraging.

METAL BEDS IN BRAZIL. — The metal-bed industry in Brazil is rapidly increasing in importance, and although this country possesses an abundance of splendid hardwoods suitable for furniture making, they are very expensive, and metal beds can be manufactured much more cheaply, and consequently are growing more popular. All the materials used in the manufacture of these products, such as tubings, casters, wire springs, knobs, etc., are almost entirely coming from England. The greatest demand is for iron tubing of various diameters, suitable for different beds, ranging from those for infants to double beds for adults. The cutting in proper lengths, bending, and painting are all done in Brazil. Most of the brass bedsteads now being sold, and the number is limited, are imported already made complete.

COTTON FOR PAPER.—The *Paper Makers' Monthly Journal* tells of an enterprising American cotton manufacturer who has been sending out to his customers a sample letter printed on cotton goods. The text of the letter reads as follows: "While not made primarily for that purpose, you will see that the material on which this letter is written answers quite well for that purpose, and also, as shown, makes a satisfactory carbon copy. If desired, of course, it could be made even a little stiffer yet. The cost of this exact fabric and finish figures out about 3 dols. per thousand sheets unprinted, whereas the unprinted sheets we use of paper costs us 2.50 dols. per thousand. We do not claim that this cloth should be used permanently in place of paper, but merely claim for it something of a novelty while about half the population of this country seems to be crazy on the subject of finding some use for the surplus cotton." It is claimed that it would be exceedingly useful for advertising purposes. It works very well on a typewriter and makes excellent carbon copies.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

JANUARY 20.—J. A. HUNTER, "The Textile Industries of Great Britain and of Germany." LORD ROTHERHAM, President of the Textile Institute, will preside.

JANUARY 27.—HON. JOHN COLLIER, R.O.I., "Portrait Painting." LORD SANDERSON, G.C.B., K.C.M.G., will preside.

FEBRUARY 3. — OCTAVIUS CHARLES BEALE, Chairman of the Australian Manufacturers' Association, "Imperial Industrial Development after the War."

FEBRUARY 10.—F. VINCENT BROOKS, "British Lithography in 1915."

FEBRUARY 17.—ARTHUR WILCOCK, "Decorative Textiles, and the Designer's Relation to the Industry."

FEBRUARY 24.—W. J. ASHLEY, M.A., M.Com., Ph.D., Professor of Commerce in the University of Birmingham, "The Economics of the War."

MARCH 3.—WILLIAM POEL, "Shakespeare's Profession."

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

JANUARY 21.—HENRY JOHN ELWES, F.R.S., "Nepal." The RIGHT HON. SIR HERBERT MAXWELL, Bt., F.R.S., will preside.

FEBRUARY 11. — CAPTAIN SIR GEORGE DUFF DUNBAR, Bt., I.A., "Tribes of the Brahmaputra Valley." LIEUT.-COLONEL SIR FRANCIS YOUNGHUSBAND, K.C.I.E., LL.D., D.Sc., will preside.

MARCH 18. — LIEUT.-COLONEL A. C. YATE, I.A. (retired), "The Indian Army."

APRIL 15.—M. M. S. GUBBAY, I.C.S., "Indian Trade and the War."

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

JANUARY 26. — MAJOR E. H. M. LEGGETT, R.E., D.S.O., Managing Director of the British East Africa Corporation, "The Economic Development of British East Africa and Uganda."

FEBRUARY 2.—EDWARD R. DAVSON, "Sugar and the War."

MAY 4.—S. CHAS. PHILLIPS, M.S.C.I., "The Empire's Resources in Paper-making Materials."

Dates to be hereafter announced:—

THOMAS WORTHINGTON, "The Work of the Commercial Intelligence Branch of the Board of Trade."

T. Thorne Baker, "The Industrial Uses of Radium."

Frank Baines, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

E. W. Hulme, "Patent Law."

H. M. Thornton, "The Industrial Uses of Coal Gas."

D. Y. Cameron, A.R.A., R.E., "Etching."

Roger Fry, "Post Impressionism in Design."

C. H. Sherrill, "Ancient Stained Glass."

A. S. E. Ackermann, B.Sc., Assoc.M.Inst.C.E., "The Utilisation of Solar Energy."

Lady Lugard, "The Work of the War Refugees' Committee."

Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

Indian Section.

Thursday afternoons, at 4.30 o'clock :—

April 15, May 13.

Colonial Section.

Tuesday afternoons, at 4.30 o'clock :—

March 2, 30.

Cantor Lectures.

Monday evenings, at 8 o'clock :—

F. Mollwo Perkin, Ph.D., F.I.C., F.C.S., M.Inst.P.Tech., "Oils, their Production and Manufacture." Three Lectures.

Syllabus.

Lecture I.—January 18.—Mineral oils—Historical — Their sources — Oil-fields and their distribution — The production and refining of natural mineral oils—The shale-oil industry and its possibilities.

Lecture II. — January 25. — Low temperature carbonisation—cracking of oils—Motor spirit—Fuel oils.

Lecture III.—February 1.—Vegetable oils—Raw materials—Sources of supply—Methods of manufacture—Methods of refining—Edible oils—paint oils.

M. H. Baillie Scott, "House Building—Past and Present." Three Lectures.

March 15, 22, 29.

David Sommerville, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

Fothergill Lectures.

Monday evenings, at 8 o'clock :—

Professor Vivian B. Lewes, F.I.C., F.C.S., "Motor Fuel." Three Lectures.

February 15, 22, March 1.

Juvenile Lecture.

Wednesday afternoon, at 5 o'clock :—

H. Plunket Greene, "How to Sing a Song." Two lectures, with vocal illustrations.

January 13.

MEETINGS FOR THE ENSUING WEEK.

Monday, January 11...Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 3.30 p.m. (Juvenile Lecture.) H.H. the Ranee of Sarawak, "Sarawak and its People."

Surveyors' Institution, 12, Great George-street, S.W., 8 p.m. Discussion on Mr. L. O. Matthew's paper, "The Report of the Land Enquiry Committee on the Acquisition of Land."

Geographical Society, Burlington Gardens, W., 8.30 p.m. Mr. H. Raeburn, "The Adai Group of the Caucasus."

Tuesday, January 12...Asiatic Society, 22, Albemarle-street, W., 4 p.m. Lieut.-Colonel P. M. Sykes, "The History of Persia."

Civil Engineers, Institution of, Great George-street, S.W., 8 p.m. Mr. A. L. Bell, "The Lateral Pressure and Resistance of Clay, and the Supporting Power of Clay Foundations."

Electrical Engineers, Institution of (Local Section), 17, Albert-square, Manchester, 7.30 p.m. Dr. S. P. Smith and Mr. R. S. H. Boulding, "The Shape of the Pressure Wave in Electrical Machinery."

(Scottish Section.) Princes-street Station Hotel, Edinburgh, 8 p.m. Mr. C. J. Beaver, "Cables."

Wednesday, January 13..Royal Society of Arts, John-street, Adelphi, W.C., 5 p.m. (Juvenile Lecture.) Mr. H. Plunket Greene, "How to Sing a Song." (Lecture II.)

Electrical Engineers, Institution of (Yorkshire Section), Philosophical Hall, Leeds, 7 p.m. Mr. E. B. Wedmore, "Automatic Protective Switchgear for Alternating-current Systems"

Automobile Engineers, Institution of, at the Institution of Mechanical Engineers, Storey's-gate, S.W., 8 p.m. Mr. T. Clarkson, "Wheels for Commercial Motors."

Literature, Royal Society of, 20, Hanover-square, W., 5.15 p.m. Professor Sir Henry Newbolt, "Shakespeare's Non-Historical Plays."

Thursday, January 14 . Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mr. H. Selby, "Rambles in Donegal."

Electrical Engineers, Institution of, Victoria-embankment, W.C., 8 p.m. Dr. S. P. Smith and Mr. R. S. H. Boulding, "The Shape of the Pressure Wave in Electrical Machinery."

Friday, January 15...Chadwick Public Lectures, at the Royal Society of Arts, John-street, Adelphi, W.C., 5.15 p.m. Dr. F. M. Sandwith, "War and Disease." (Lecture I.)

Offer of Set of Journals.—A Fellow of the Society offers to present a complete set of the *Journal of the Royal Society of Arts*, from 1882 to the present date, to any Library which would care to accept them. The numbers are unbound.

Journal of the Royal Society of Arts.

No. 3,243. VOL. LXIII.

FRIDAY, JANUARY 15, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, JANUARY 18th, 8 p.m. (Cantor Lecture.) F. MOLLWO PERKIN, Ph.D., F.I.C., F.C.S., M.Inst.P.Tech., "Oils, their Production and Manufacture." (Lecture I.)

WEDNESDAY, JANUARY 20th, 8 p.m. (Ordinary Meeting.) J. A. HUNTER, "The Textile Industries of Great Britain and of Germany." LORD ROTHERHAM, President of the Textile Institute, will preside.

THURSDAY, JANUARY 21st, 4.30 p.m. (Indian Section.) HENRY JOHN ELWES, F.R.S., "Nepal." The RIGHT HON. SIR HERBERT MAXWELL, Bt., F.R.S., will preside.

Further particulars of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

On Wednesday afternoon, January 13th, Mr. H. PLUNKET GREENE delivered the second and concluding lecture of his course on "How to Sing a Song."

He began by recapitulating the principal points of his first lecture, and insisted especially on the importance of imagination in a singer. In addition to the points mentioned last week as being necessary to a singer, Mr. Plunket Greene desired to add one more—style. It was difficult to define style, but an idea of it might be derived from the old tag, *Ars est celare artem*, which might be freely rendered, "Do not give the show away."

The first lecture was devoted to considering how to sing; that day the lecturer proposed to deal with the songs which a singer could sing. Songs were of two classes—those in which the voice was used simply as a musical instrument, and those in which the words were the important thing. The latter were by far the most interesting to sing as the singer could be dramatic. Out of every hundred songs, said the lecturer, ninety-five belonged to the first class.

A very large number of songs deal with the supernatural, fairies, ghosts, witches, and so forth, *e.g.*, among the songs which he was going to sing the first three were supernatural, and this though the songs had been chosen without any regard to this point.

In illustration of the various points discussed in the lecture, Mr. Plunket Greene then sang the following songs:—

	Atmospheric.	
1	The Fairy Lough . . .	C. V. Stanford
	Dramatic.	
2	The Erl-King	Schubert
3	Scared	C. V. Stanford
	Narrative.	
4	The Twa Sisters o' Binnorie (Old Scotch Ballad)	*Arranged by* Arthur Somervell
	Characterisation.	
5	Autolycus' Song . . .	H. Walford Davies
	Reminiscence.	
6	When Childher Plays .	H. Walford Davies
	Contemplative.	
7	Drake's Drum	C. V. Stanford
	Address or Ode Songs.	
8	Daddy-Long-Legs . .	C. V. Stanford
	Bel Canto and Rhythmical.	
9	(*a*) Boat Song . . .	C. V. Stanford
	(*b*) Trottin' to the Fair (Old Irish)	*Arranged by* C. V. Stanford
	Ghost.	
10	The Twa Sisters o' Binnorie (Old Scotch Ballad)	*As above*
	Question and Answer.	
11	(*a*) The City Child . .	C. V. Stanford
	(*b*) Mary	A. M. Goodhart
	Humorous.	
12	The Crocodile (Old English)	*Arranged by* Lucy Broadwood

At the conclusion of the lecture the Chairman said that from what had been said about magnetism — by which was really meant sympathy between the lecturer and his audience —it must be quite obvious to Mr. Plunket Greene that they had greatly enjoyed his lectures. He would therefore content himself with moving a hearty vote of thanks to the lecturer for his interesting course, and to Mr. S. Liddle, whose brilliant accompaniments had added so much charm to the illustrative songs.

The vote of thanks was unanimously carried, and the meeting terminated.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE HISTORY AND PRACTICE OF THE ART OF PRINTING.

By R. A. PEDDIE,
Librarian, St. Bride Foundation Typographical Library.

Lecture IV.—Delivered December 14th, 1914.

The recent history of colour printing is divided easily into two sections—non-photographic and photographic. Each section comprises three methods — intaglio, relief, and planographic, so that the subject is comprised in these main headings :—

NON-PHOTOGRAPHIC.

Intaglio.—Etchings and copperplate prints of all kinds, in colour.

Relief.—Chromo-Xylography.

Planographic.—Chromo-Lithography.

PHOTOGRAPHIC.

Intaglio.—Photogravure.

Relief.—Half-tone.

Planographic.—Photo-Chromo-Lithography, Chromo-Collotype.

Doubtful and combination processes, of course, add to the number.

CHROMO-LITHOGRAPHY.

The period I am dealing with in this lecture begins with the rise of chromo-lithography.

By 1850 the problem of the super-imposition of colours had been solved, and the art started on its triumphal course. In 1856–57 Lemercier, of Paris, printed an edition of the "Imitatio Christi" for which illuminated borders were copied from early manuscripts, and every page was decorated. In England, Owen Jones was working on his "Grammar of Ornament." It was printed by Day & Son, who were at this time the leading chromo-lithographers in London.

The most important non-commercial application of chromo-lithography was begun in 1856 by the Arundel Society, which issued prints of Italian frescoes until quite recent years. They were not all printed in England, some well-known German firms producing many of the later prints.

The "oleograph," a rather distressing form of the chromo-lithograph, was of German origin The finished print was thickly coated with varnish and then passed between patterned rollers giving the impression of canvas.

In the early days of chromo-litho work, the prints were frequently produced on thin paper. After printing, the margins were cut off and the print mounted on thicker paper, or, in the case of book illustration, mounted on the pages left for them. In several cases of books in the early fifties, spaces were left for illustrations to be mounted on the same pages as the text.

The method of chromo-lithography is shown very well in Audsley's book on the subject. The object—say, a water-colour drawing—is dissected by the litho artist into the number of separate tints required for its reproduction. A key plate in black is produced, and as many pulls taken as the number of printings required. The part of the design to be printed in each colour or tint is then transferred to a separate stone. The series of progressive proofs in Audsley's book shows how a picture is built up by the successive printings.

The history of chromo-lithography during the last sixty years (except in its association with one or other of the photographic processes, which is dealt with later) is a history of technical improvements rather than of revolutionary change. Better work can be done and is done to-day than at any previous period, owing to these improvements in ink, paper, and machines. Photography has, no doubt, closed many doors to chromo-litho work, but there are many fields in which it retains its supremacy. Artists have turned their attention to it in recent years, and many auto-chromo-lithos have been produced. The style found to harmonise best with the process is curiously similar to the plates in the first book printed by Hullmandel by his chromo-lithographic method. It is possible that there are greater artistic developments ahead for this method of work.

The offset machine which I described in the third lecture has been adapted for colour work. Here its ability to print on any surface paper is of exceptional value, and the softness of the colouring of some offset productions is very effective.

COPPERPLATE PRINTING IN COLOURS.

Intaglio plates—that is, mezzotints, stipples, and line engravings—are printed in colours to-day in exactly the same way as in the eighteenth century. The plate is inked by hand with all the colours necessary—practically painted—and the whole printed at one impression. The modern development described as colour etching has various exponents. By some the plate is printed twice, first for the broad masses of colour, and secondly for the actual lines of the

etching. The specimens shown by Hugh Paton and V. Preisler sufficiently indicate the scope and method of this process.

Wood-block Colour Printing.

In relief printing the most interesting process after 1850 is wood-block colour printing. This process, where separate blocks are used for each colour, gives an impression of transparency which cannot be obtained by any other.

This method of colour work was carried to a considerable pitch of excellence by Savage about 1820, and it was probably after seeing his work that Thomas Bewick suggested the printing of pictures in colours by means of wood-blocks. It was not, however, until about 1850 that wood-block printing became at all common.

The two most effective English workers in chromo-xylography were Edmund Evans and Benjamin Fawcett. The latter is a striking instance of unaided genius working alone and producing effective work. His illustrations to Morris's "British Birds" will alone suffice to keep his name in the annals of great colour printers. The book illustrations of Edmund Evans are, perhaps, the best examples of pure wood-block colour work carried out in this country.

The most typical works of Evans in later years have been the books of Walter Crane, Kate Greenaway, and Randolph Caldecott, specimens of whose works are on show, together with some earlier productions for the purpose of comparison.

Chromo-xylography is not prominent in the colour work of the Continental printers. But there is one exception. The firm of Knöfler, of Vienna, founded about 1856, has produced work of the highest character by this process. Religious prints of all kinds have been their speciality, and the transparency of the colours and the general beauty of their work give the firm a very high place among colour printers.

Miscellaneous Methods.

There are a few processes of colour printing which do not quite come under any of the headings I have adopted, and these I propose to take, perhaps out of their order, so that the latter part of my lecture can be devoted to the photographic processes. An important machine in this class is the Orloff. This is the invention of a Russian engineer, and is used in the State Printing Office at Petrograd for printing bank notes and similar colour work. The method of printing is quite different from any other. On a large cylinder are fastened the various printing blocks, one for each colour. A series of inking devices apply the correct colour to each block as the cylinder revolves. These blocks transfer their colours to composition rollers, which in turn apply it to the "form" block. All the colours are by this means superimposed on this form block, which then comes in contact with the paper and deposits the whole of the colours at one impression. It might be imagined that this process of superimposition of wet colours would cause smudging or blurring, but work produced by the Orloff press is noticeable for clearness of outline and delicacy of detail. The machine has been put on the English market once or twice, but has never been adopted.

Another recent process of interest is stencilling by machine. This method has been considerably used for roughly colouring plates. It has now been made possible to stencil by machine, Orsoni's Aquatype having been invented in 1898 and since perfected. The sheets or prints to be coloured are fed on to a travelling band, which carries them in turn under as many stencils as there are colours to be applied, when another portion of the mechanism passes a colour brush over the stencil then in position on the sheet. Some of the French fashion papers have their plates tinted by this machine, which is also extensively used for picture postcards.

Photographic Processes.

The whole of the photographic colour processes may be divided into two series. The first includes all those in which the photograph is merely the basic plate or outline, and the colours are selected by eye and printed over it. Postcards, for instance, are frequently printed with a collotype basis and lithographic colouring. As far back as 1858 Geo. Baxter patented a method of colouring photographic prints lithographically. These combinations are too numerous to mention.

Photogravure.

Photogravure plates are frequently printed from in colour by the old eighteenth-century method of inking the plate with all the colours and printing at one impression. The facsimiles of the paintings of G. F. Watts have been produced by Messrs. Emery Walker in this manner. Before leaving photogravure it must be mentioned that constant attempts have been made to print photogravures in colour by machine. This process has been adapted to fast rotary printing in monochrome, and flat

bed machine photogravure is common; but with the exception of a few experiments, machine-printed photogravure in colours belongs to the history of the future, and is therefore outside the scope of this paper.

There is, however, one process which has not yet been made public that I may refer to. This is a combination of the intaglio and offset methods, and the experimental prints have been made by Mr. Geo. W. Jones. The machine is called the Renaissance, and is made by Linotype & Machinery, Ltd. Instead of a copper cylinder, as in the ordinary photogravure machines, a strip or sheet of copper is used, and the picture etched on the flat sheet, which is then bent round the cylinder. The wiping is done with rollers instead of the ordinary steel knife, and the impression is taken on a rubber cylinder, which transfers it to the paper. The first experiment made in colour on this machine was a reversed half-tone three-colour, but later photogravure negatives have been used with very effective results. A high-grade softness of colour is produced, and the high lights are better cleaned than with the pure photogravure method. It will be very interesting to see the later work of this machine. The colour prints by the Rembrandt Intaglio Engraving Co. in two and three printings are by a secret photogravure process.

Three-colour Process.

I now have to deal with the three-colour process, and describe how the automatic selection of colour was invented and developed. The idea of three-colour printing was not new, having been used by Le Blon in the eighteenth century. His ideas were based on the investigations of Sir Isaac Newton. Further researches in the early part of the nineteenth century by Dr. Thomas Young led him to put forward the theory of three primary colour sensations; but until Helmholtz revived it in 1853 it had been shelved. In 1860 Clerk Maxwell made a complete study of the subject, with the result that in 1861 he was able to take three photographs of a piece of coloured ribbon through three coloured light filters. By superimposing the three images obtained, and projecting them in an optical lantern through the three filters, he obtained a coloured image of the ribbon. This image was not perfect, owing to the fact that photographic plates were not at that time sensitive to red and green. It was suggested, very shortly after, to apply the principle to colour printing, but the photographic plate difficulty was not removed until 1873, and then only partially, while the complete discovery of the principle of colour sensitive plates did not come about until the early eighties. Dr. E. Vogel in Germany, and Mr. F. E. Ives in America, were proceeding on very similar lines. Mr. Ives had already invented the cross-line screen, and it is owing to his researches that the three-colour block process became possible.

He exhibited at the Philadelphia Exhibition of 1885 prints made by this process, but thought so little of it that he did not trouble to patent it. At that time the colour filters and the half-tone screens were comparatively imperfect, and commercial work was still some distance off. Not until 1891 was any commercial work put forward, and in the latter part of this year several English firms took the process up. One of the first three-colour prints produced in this country was a plate representing the famous racehorse that won the Derby in 1890. This was produced by Messrs. Waterlow & Son in February, 1892, as a supplement to the paper *Land and Water*. The improvements in the process that have taken place since that time are purely technical, the character of the process remaining the same.

The technical description of the process which follows is taken from Gen. Waterhouse's introduction to the catalogue of the photo-engraving exhibition at South Kensington:—

"The problem to be solved in photographic three-colour printing is a complicated one, because the light reflected from the objects to be reproduced must first be analysed and divided into its three components, red, green, and blue-violet, by means of carefully selected coloured screens or filters, so that each of them may impress a negative image, or colour-record, upon three suitably sensitised photographic plates of the parts of the object containing it, the densities of the three images being proportionate to the quantity of each light passing through the screens and its luminosity. These three images must correspond exactly in size, so that they may register correctly.

"From these three colour-sensation negatives, positive prints are made suitable for the process selected, whether by superposition of transparent films, collotype or block printing, and must be printed in three colours or pigments, complementary to the filters used, viz., cyan-blue for the red sensation negative, crimson for the green, and yellow for the blue-violet.

"The correct combination of these three should reproduce the colours of the original.

Owing to the difficulty of obtaining suitable permanent pigments to meet the theoretical requirements in three-colour block printing, some workers add a fourth block printed in grey or black, to give strength and harmonise the colours. The greatest care has to be taken throughout in the proper selection and adjustment of filters, photographic plates and printing colours. The least divergence throws out the balance and produces a false effect.

"Practically it means the mutual adjustment of at least three different sets of three variable factors with almost mathematical accuracy. The printing processes are still imperfect, but the discovery of new sensitisers for the photographic plates, and fuller researches into theory and practice, are bringing about constant improvements, and it seems likely that before long their use will be greatly extended."

The method of photographic colour selection can be and is applied to the other photographic processes, but not yet to anything like the same extent as to the half-tone process.

The improvement in printing due to the introduction of more perfect machinery has had a considerable influence on the three-colour process. The two-revolution type of machine, such as the Miehle or Century, was found to give better register and possess more inking power, which has helped the process. Then, too, the platen press has of late years improved in strength of impression and inking power, which has enabled it to be used for colour work. The question of the ink is a serious one. It has improved in quality and in accuracy of tint, but the permanency of the colours still leaves much to be desired.

Several machines for simultaneous printing of colours have been invented. With the exception of the Orloff already mentioned, none appear to have survived. The Miehle machine has been adapted for continuous colour printing by joining three machines together by means of a special delivery apparatus, so that when the sheet leaves one machine it passes to the next, and so to the third.

The four-colour process is described in the following extract from Mr. W. Gamble's article on "Modern Colour Processes":—

"Whether to use three or four colours has long been one of the contested points in colour work. The theoretical advocates of three colours have stoutly held out for three-colour; but many practical men hold the faith that three colours can never give an entirely satisfactory rendering of the subject. The weakness of the three-colour process is chiefly found in the rendering of blue in all its gradations, in its inability to yield a good grey, and in the imperfection of the blacks, which, according to theory, should be formed by the superposing of the three colours in equal strength. The remedy proposed is to use a black or neutral grey as a fourth printing. Dr. Albert advocated this in his citochrome process, and many leading Continental workers have followed him. In America a firm known as the Quadricolour Company make it a rule to use four colours, and do admirable work. It is, indeed, quite general in America to find four-colour being given the preference to three, especially in blocks produced by hand processes. In England, though four-colour work is not so general, a fourth printing in black is often resorted to, or one of the trichromatic colours is run twice through to get increased strength.

"An interesting attempt to found a four-colour system of colour printing was the complementary colour process of Mr. C. G. Zander, which was patented in 1905. The inventor assumed that it was necessary to use, not three but four fundamental colours, viz., red, yellow, green, and blue, by mixtures of which in suitable proportions any colours in Nature could be matched or produced. The hues of these four fundamental (or monochromatic) colours may in popular terms be described as magenta red, lemon yellow, emerald green, and ultramarine blue. The four colours were grouped into two pairs of complementary colours, viz., red and green, yellow and blue, so that when the elements of either pair were mechanically mixed as pigments, by printing or staining they produced black. At first sight it might seem that the only difference from the ordinary process was the addition of a green printing colour, but actually the other colours have been scientifically adjusted or readjusted, so that they form two pairs of complementary colours. The author of this process claimed that practically the whole range of the spectrum colours could be produced by it, besides extra-spectral purples, dense pure black, and homogeneous greys. Mr. Zander asserts that no pure black can be reproduced at all in three-colour printing, whilst by his new process either of the two pairs would produce black or grey. Several specimens were produced by this process, and it certainly appeared capable of rendering more brilliantly the bright colours of flowers, ribbons, etc.; but the results were not entirely convincing, probably through

the engravers not having sufficient practice with the new method. Printers did not view with favour the idea of a fourth printing, and on the whole the process was received so coldly that the inventor has not pushed it further."

Collotype

Experiments with a view to using the collotype process for colour printing were made by Albert in Munich and Husnik of Prague in the early 'seventies, and the State Paper Office in Petrograd was producing colour collotypes by 1878. H. W. Vogel introduced colour-sensitive photographic plates about this time, and prints in collotype by this means were extensively made in Germany in the late eighties. Several firms in England adopted the process about 1890, among them Messrs. Waterlow & Sons. In 1890–91 this firm produced some very excellent work, but the process was not suitable for the English climate, and the introduction of the three-colour half-tone resulted in its abandonment as far as rapid commercial work was concerned. Of recent years collotype colour work has again come to the front, principally on the Continent, although a few English firms have done very well with the process. Messrs. Emery Walker have produced some very fine specimens of collotype in colours, which I am able to show.

During this survey of the recent history of colour printing, we see in the first period the rise of chromo-lithography and its only rival, chromo-xylography. With the exception of a few experiments, these two methods hold their own until the coming of three-colour work about 1890. The triumphal march of the three-colour process, with its accompanying disadvantages of clay-coated paper and fugitive inks, still continues, but there are signs of improvement. The development of the litho offset and photogravure processes are all for the betterment of colour work. The same disadvantages do not apply to them, and so there is a hope that we may presently have a process of colour reproduction that will be accurate, cheap, printed in fast colours, and on paper that will not fall to pieces after a few years or turn into a clay brick if it gets damp.

[Note.—Each lecture was illustrated by lantern-slides and an exhibition of specimens of printing. The exhibits were individually described after the lecture.]

THE UTILISATION OF PEAT IN ITALY.*

Several of the more important peat beds in Italy have been worked chiefly with a view of utilising the peat as fuel. Most of the peat is, however, too poor to compete with imported coal; hence the lack of success of all such undertakings even where they were connected with land reclamation schemes. Attempts have also been made to use peat for other purposes, such as litter, packing and isolating material, etc., but the quantities thus used are too insignificant to be of any economic importance. Of late, however, the nitrogen contained in peat has attracted considerable attention; this nitrogen is practically in an inert condition in the raw material, and in order to utilise peat successfully as a manure the nitrogen must be transformed into a more active compound such as a salt of ammonia.

The idea of subjecting peat to the water-gas process was suggested by Dr. L. Mond, and the first plant erected for the purpose was that at Orentano in the province of Lucca, Italy; it has since been much improved by the addition of plant for preparing and drying the peat. The next important works of the kind were those at Osnabruck (Hanover) under the direction of Drs. Frank and Caro, but owing to the difficulties connected with the preparation and drying of the peat, these works may be considered as being still in the experimental stage, as are other works started in England. The last works to be erected were those at Codigoro, Italy, where all difficulties have been successfully overcome. In fact the only two important undertakings for the utilisation of peat are those of Orentano and Codigoro belonging to the "Società per l' utilizzazione dei combustibili italiani."

The process adopted for treating peat is the following: The peat, properly dried and broken up, is thrown into a turret-shaped oven 26 ft. to 33 ft. high, called the gas oven, which is fed at intervals from the top. The peat burns only in the lower part of the turret, the combustion being regulated by a jet of hot air and steam. The water vapour decomposes on the incandescent mass, producing, together with the other combustion gases, the so-called water gas, or in this case Mond gas, which collects in the top of the oven. It is produced at the lowest possible temperature, and the nitrogen evolved from the peat combines with the nascent hydrogen and forms ammonia. The gas thus produced is then washed to free it from the tarry products it contains and led into a leaden chamber where it is met by a spray of sulphuric acid which converts the ammonia into sulphate, while the remaining gas is purified, cooled and burned under the steam boilers, in the drying ovens or in gas motors. In this way about three-

* Summary of a lecture by Professor Ugo Rossi given at a meeting of the Association of Italian Agriculturists. Reprinted from the "Monthly Bulletin of Agricultural Intelligence," Rome.

quarters of the quantity of nitrogen contained in the peat is converted into sulphate of ammonia. A peat containing 2·5 per cent. of nitrogen yields about 175 lbs. of sulphate of ammonia to the ton.

The first factory was erected at Orentano in 1907, but only began to work in 1910. At first the peat was dried in the open, but as this system proved quite unsatisfactory artificial drying was resorted to. Peat taken from the pit contains 50 per cent. by weight of water, and this quantity is now most successfully reduced to 25 per cent.

At present 1,800 cubic ft. of peat can be treated daily, yielding 50 tons of sulphate of ammonia per month, and before long the output will be doubled. The gas is used in the works and at a central station developing about 800 h.p.

The results obtained at Orentano encouraged the company to erect large works at Codigoro (Ferrara, Italy) in 1912; these are now capable of dealing with 150 tons of dried peat daily, and of turning out from 10 to 12 tons of sulphate of ammonia per day. The peat beds at Codigoro are upwards of 2,500 acres in extent. The company has already spent £240,000 on the two factories, but it can now produce sulphate of ammonia at 4*s.* 10*d.* to 5*s.* 7*d.* per cwt., while the market price is above 12*s.* per cwt.

FOREST FIRES IN THE SOUTH OF FRANCE.

Some idea of the immense damage caused by forest fires in the departments of the south-east of France is given in a report lately published by the *Syndicat forestier de Provence.* It appears that, notwithstanding the exceptionally dry summer in 1913, only two fires of importance occurred in two of the departments, namely, one at Quinson in the Basses Alpes, and the other in the neighbourhood of Auribeau in that of the Alpes Maritimes.

In the Department of the Bouches-du-Rhône, where the forests cover an area of 85,579 hectares (211,380 acres), of which 25,087 hectares (61,965 acres) are the property of the State, and 60,492 hectares (149,415 acres) belong to private owners, the damage done by fire was comparatively insignificant, being 230 hectares (568 acres), which was the result of eight outbreaks, one of which was attended by loss of life.

On the other hand, the Department of the Var seems to have suffered very severely, and of a total area of 260,000 hectares (622,200 acres, nearly 1,000 square miles) no fewer than 12,384 hectares (30,588 acres), or about 5 per cent., were destroyed by twenty-six fires which occurred between May and September.

Of these 12,384 hectares of forest, 11,040 hectares (27,268 acres) were burnt in six fires which occurred during the months of July and August. The two largest of these, viz., at Bormes and at Ollières, destroyed upwards of 3,000 hectares (nearly 7,500 acres) each.

The other twenty fires were from two hectares (five acres) to 350 hectares (864 acres) in extent, and no account is taken of many minor outbreaks when less than two acres of forest was destroyed.

The timber destroyed consisted chiefly of various species of oak, including a large proportion of cork trees, and covered an area of 7,495 hectares (18,512 acres); the remainder, 4,889 hectares (12,076 acres) in extent, were pines.

With regard to the causes of these fires, nineteen are attributed to negligence or imprudence, probably, in most cases, originated by lighting fires in or in the neighbourhood of woods or forests, four were attributed to malice, and three to negligence and malice combined. In six cases the assistance of the military was called into requisition to stop the progress of the flames, whilst in nineteen cases the fires were extinguished by the inhabitants in the neighbourhood, and in one case only did the fire burn itself out. In most cases aid arrived too late.

Many suggestions are made for the prevention of forest fires, or for arresting their progress when once alight. Unfortunately the heavy expenditure that would be incurred in many of these plans renders their application impracticable.

PHILIPPINE PROGRESS IN BASKET-MAKING.

The most notable feature of the basket-work exhibited at the last Philippine Exhibition was the note of uniformity of design throughout the whole. Every part of the archipelago was represented by practically the same type of baskets. This uniformity has resulted from a campaign carried on by the Bureau of Education, under whose supervision practically all the basket-making for the export trade is done. Another noteworthy feature was the large number of types of bamboo-nito and all-bamboo baskets, copied from indigenous types that have been standardised. Some of these are closely akin to Javanese and Bornean kinds. Considerable stress is laid on the symbolism of the native types, and the opinion, borne out by market experience, is that these indigenous types are more profitable than the evolved or copied types, such as the Polangui and coiled baskets.

Among the most popular types in the exhibit which are being made for the trade may be mentioned the following, says the American Consul at Manila: A miniature bamboo-nito rice-holding basket covered with a miniature winnowing basket of the same material made in Pangasinan—this is popular for a trinket basket; buyo boxes, after an old Iloilo pattern with zigzag decorations on the side and bottom; the nito basket, sewn through the strip of bamboo that forms the side, after an old Malayan form of decoration, the top decorated with black wood inlaid on white wood, representing two birds; the small Igorol camote basket; the harvest basket from Palawan; the fishing basket of the Ilocano, with superimposed blackened bamboo spokes; a very old type of holding

basket in a weave common to the Skanras of North Borneo, the Tirrurays of Mendanao, and the Japanese; the oblong buyo box of Iloilo; the ceremonial marriage basket of the Batangas Tagalogs; modifications of the Ilocano fishing basket in forms of waste-paper baskets, sewing baskets, and work-baskets; the rice harvesting basket of Cuyo, with typical Cuyo rim perforated and decorated with a nito binder; the Cuyo planting basket, used for holding the seed of upland rice; the seed basket of Calawit, Busuanga, the rim finished with a type of centipede weave in nito, a design exceptionally even and the weave fine; cigarette cases of blackened bamboo from Busuanga; buri boxes; buyo boxes of North Palawan, of fine work and interesting symbolism.

Baskets of the evolved types shown in the exhibit were: all-wool bamboo work-baskets from Pampanga; bamboo-nito handkerchief and collar boxes; winnowing baskets, mosaic design in coloured bamboo strips, the edge bound with nito, from Iloilo; handbag design, card trays, button boxes from Bulacan. The Polangui baskets of standard types and ornate designs show evidence of great popularity abroad. Unfortunately, the material from which they are constructed is difficult to secure in thickly populated districts where makers abound. The provinces where this material grows abundantly are sparsely populated. In view of this fact, it is probable that the supply of this class of basket for export will be limited. About Polangui, Albay, where this basket originated, already the supply of materials is diminishing. These baskets are becoming popular in the United States, and local agents are buying large supplies for well-known American firms. The provinces of Mendoro and Misamis are well supplied with the materials for this type of basket, but lack workers.

The coiled stem baskets consist of rattan, nito, and lukmoy. The rattans come from Nueva Vizcaya. The best nito work comes from Samar, where the coiled nito baskets are mostly produced. These materials are formed into desk trays, tie boxes, button boxes, jewel boxes, and round and rectangular trays. The coiled strip baskets exhibited were largely of new design and untried as to durability. There were shown a market basket of coiled karagumoy strips, with lukmoy and rattan body; a large tray of lupids on rattan made in Bohol; a striking black-and-white work-basket made in Albay; a jar-shaped one of bamboo coiled work made in Bulacan; a small tray of buri-leaf strips coiled on lukmoy, made in Mindoro; pin trays in lupis coiled on rattan, made in Samar. These coiled strip baskets present a very favourable appearance and are liked by connoisseurs, but they have not proved themselves on the market. The division of the exhibit devoted to the plaited buri and pandan baskets displayed some fine samples of karagumoy baskets from Albay Province, and some excellent buri baskets from Romblon and Capiz Provinces.

Pandan is a material widely distributed in the islands and easily obtainable, but the lasting qualities of the material have not been given a thorough test. The coiled fibre baskets of abaca (Manila hemp) and maguey coiled on rattan are giving great satisfaction. These baskets come principally from Southern Luzon and the Visayas, where abaca is chiefly grown, and the Ilocano Province, where maguey is extensively cultivated. In this kind of basket the design of the noted Philippine moth is seen to the best advantage. Many of these types nest or telescope well, and are suited to export. In durability they are probably unsurpassed, and they offer a wide range for new designs.

There remains to be noted the line of "air root" baskets or hand-bags, made chiefly in Tayabas from the material known locally as lukmoy, elsewhere as "air root." These hand-bags were designed to take the place of the Japanese article formerly so largely imported into the islands, and have to a great measure done so. The hand-bag is growing in local favour, and may well supersede the imported article and compete with it in outside markets eventually. The same material is made into other popular types, such as covered work-baskets, which of course are less convenient for export. In view of the great wealth of the material and the intelligence of native workers under proper training, the basket-making industry is going forward by leaps and bounds in the Philippines, and promises to become one of the leading industries when time and experience shall have more completely mastered the intricacies of providing for an export trade. The necessity of manufacturing for the foreign market has in recent years tended to eliminate many of the more flimsy classes of baskets, and to emphasise durability and shipping facility. For the export trade, types that nest or telescope readily are evolving, particularly in the larger makes.

THE PANAMA HAT.

It is believed that the first toquilla or Panama straw hat was made 285 years ago in the province of Manavi in Ecuador. In those days Panama was the chief distributing emporium for articles produced on the west coast of South America, so hats woven from the toquilla straw in Manavi, and exported from Panama, came to be called Panama hats, and the name has clung to the well-known fabric ever since. The plants which yield the toquilla straw are a species of stemless screw pines, the most important growing wild in the hot, moist regions of Ecuador and Colombia, and also along the head-waters of the Amazon. They attain a height of 6 feet to 10 feet, and present the appearance of diminutive fan-shaped palm trees. Many attempts have been made to cultivate the plants, but unsuccessfully, for it seems to be only in the wild state that the characteristic qualities are developed. The seeds are sown in furrows on low, wet land, during the rainy season, after which little attention is devoted to them. When about 5 feet high, the young leaves are cut before expanding, and are ready to be prepared for use.

After the removal of the veins, the leaves are dipped repeatedly in boiling water, and then exposed to the sun to be bleached. The straw is then carefully selected, its value depending upon the length, thickness, colour, and number of strands obtained from each leaf. The coarser straw is utilised in making small baskets, ornaments, bags, and other articles.

Thousands of the natives of both sexes and all ages throughout the interior of Ecuador are engaged in weaving hats, the work being carried on from a little after midnight to 7 a.m., while the air is moist, as the straw becomes brittle during the day.

The necessary qualities of a fine hat are durability, strength, elasticity, impermeability, and the ease with which it can be washed, if soiled. It may be rolled up without injury, and will last for many years, but a broken straw in the crown diminishes its value by one half. Three to six months, working four or five hours each day, are required to complete the best hats, but children will make two of the cheapest grade hats from undressed straw in a day.

The finest hats ever made, as it is said, were the work of a native Ecuadorian named Palma, which were purchased for $200, or £40 each, and presented to the Emperor Napoleon III. and Marshal MacMahon.

The only objection to the Manavi hats, so the *Bulletin of the Pan-American Union* says, is that they are all of identical shape, no attempt having been made to adapt the forms to modern tastes and ideas of fashion. A hint to be borne in mind is that injuries should be repaired at once, as otherwise the hat soon becomes valueless. When not in use the hat should be rolled up carefully and wrapped in camphored paper. During the year 1913 hats to the value of $1,127,508 were exported, principally to the United States, Germany, France, and Belgium. The toquilla straw hats are sold at prices varying from a few cents to $100 (= £20 sterling), or even more.

THE REVIVAL OF SILK CULTURE IN SPAIN.

The production of silk, which in the sixteenth, seventeenth, and eighteenth centuries formed probably the most important of Spain's industries, is being revived in Seville. Recent experiments, though limited, are encouraging. Four hundred years ago the silks of Seville, then the most famous in the world, were exported to all countries, for Spain was the first nation of Western Europe to take up silk culture. The industry was introduced under the Moors, and protected and encouraged by their Christian successors after the Spanish conquests. In 1519 there were in the city of Seville alone 16,000 silk looms. During that flourishing period the annual output of silk in the Province of Seville amounted to 880,000 lbs., and in the whole country to 27,000,000 lbs. The industry declined in the early nineteenth century owing to civil disturbances and heavy taxation, and especially to the prevalence among the silkworms of pebrine. By 1850 sericulture had entirely disappeared in the Seville district. The climate of Spain is excellent for this industry, and fine silkworms, such as were employed when silk cultivation was at its height, are available in the foothills of the Sierra Nevada, near Granada. The worm has a life of fifty days, during the first thirty of which, according to the American Consul in Seville, it grows to about 9,500 times its original weight. Ninety-six thousand small eggs of the silkworm weigh one ounce. The white mulberry tree, which grows in four years to such a size that its leaves may be utilised for feeding the silkworms, thrives in the Seville district. The tree reaches a height of 33 ft. to 49 ft., and a possible age of three hundred years. Moreover, as it puts forth new leaves after its first foliage has been gathered, it loses nothing in value as a shade tree; it is hardy in cold and drought. The Province of Seville has provided for the planting of white mulberry trees along several provincial highways. Permission has been given to persons without land to plant the trees along the now shadeless country roads, and railway companies have been requested to plant the trees along their lines. A manufacturer of silk thread in Seville has distributed gratis silkworm eggs of the first quality, and these may be purchased at cost price—about 9*s.* an ounce—from the principal promoting organisation at Murcia or Barcelona, or procured from the School of Sericulture recently established at San Juan de Aznalforache, two miles from Seville. The quantity of silk cocoons produced in Spain is estimated at 2,105,400 lbs. annually, valued at £182,000.

ARTS AND CRAFTS.

British Arts and Crafts at Paris.—The illustrated catalogue of the Exhibition of British Arts and Crafts held in Paris last year was sent round at Christmas time to the exhibitors, perhaps as a kind of gentle reminder that their possessions were still in safe keeping and that they might expect some day to have them returned to them. It is a fat quarto volume, profusely illustrated, is issued at the very reasonable price of four francs fifty centimes, and contains, besides the actual catalogue of objects exhibited, translations of short articles by well-known British craftworkers and experts treating of the various crafts. It is, therefore, a work of more than ephemeral interest. It was the custom at the earlier exhibitions of the Arts and Crafts Exhibition Society to include in the catalogue essays on different subjects connected with the exhibition, but these were naturally always written by members of the Society. The Committee for the British Exhibition in Paris was constituted on a wider basis, and the present catalogue reckons amongst its contributors not only the president of the committee (Sir Cecil

Smith) but also such well-known experts as Mr. William Burton and Mr. Alan Cole, who do not belong to the Arts and Crafts Exhibition Society. The result is that, though the greater number of the articles are written more or less from one point of view, the outlook displayed by the writers as a whole is a good deal wider than might have been expected, whilst Commendatore Walter Crane's introduction gives an admirable summary of the genesis of the Arts and Crafts movement in this country. The illustrations are, on the whole, very well produced, though in some cases a little more care would have resulted in the colour values being better preserved. The objects chosen for illustration cover a wide range. Morris tapestries, decorative paintings by Sir Edward Burne-Jones, cartoons and designs by William Morris, cartoons by Ford Maddox Brown, pottery by William de Morgan, a cretonne design by Lewis F. Day, and glass from the designs of Philip Webb, are included in the retrospective examples. The modern work embraces nearly all the artistic crafts; pottery is represented by the Pilkington Tile & Pottery Co., W. Howson Taylor, Mrs. Harold Stabler, Bernard Moore, the Martin brothers, and others; table glass by Messrs. James Powell & Sons; stained glass by R. Anning Bell, A.R.A., Harry Clarke, and others; embroidery by May Morris, and lace by the East Devon Lace Association, The Royal Irish Industries Association, and other societies as well as private workers. The illustrations of metalwork include, amongst other objects, Sir W. Goscombe John's Sceptre, a couple of maces by H. Wilson, Sir George Frampton's badge of office for the Master of the Art Workers' Guild, a two-handled vase by Omar Ramsden and Alwyn Carr, and a cup in silver and copper by J. Paul Cooper. The examples of book illustration are numerous and varied, whilst among the bindings the magnificent Dante, by Miss Adams, and the books of Douglas Cockerell deserve attention. There are some beautiful examples of letterpress from the Doves Press, and the work of Graily Hewitt, Edward Johnston, and Mrs. S. C. Cockerell shows what England can do in the way of lettering and illumination. Textiles, furniture, and wall-papers are but slightly represented.

On the whole, the catalogue is of extraordinary interest as showing at a glance better than any publication has hitherto done the results of the Arts and Crafts movement at their best. The works illustrated are representative, and they leave one with a feeling of pleased surprise at both their technical and their artistic qualities. They prove beyond a doubt that in some directions excellent work is being done. On the other hand, there is very little evidence that the movement at the present day (whatever may have been the case in the past) is doing much to help forward design for manufacture. William Morris, with all his energy and love of handwork, was happy to design wallpapers, cretonnes, and the like. The twentieth-century artist craftsman, apparently, can only be interested in work which he can execute entirely himself. Handicraft may be the gainer by this, but manufacture, and indirectly trade, are undoubtedly the losers.

Lettering, Illumination, and Printing.—It is at this season that there is always a good opportunity of judging how things are going with regard to lettering, illumination, and printing. Every year as the time draws near to Christmas, those of us who are interested in illumination and the like begin to scan the shop windows and the books of "private greeting cards" anxiously in order to see what the Christmas and New Year cards will be like. The tendency within recent years has been so much towards simple greetings, with perhaps illuminated initials or borders, that nowadays one has hardly to take account of purely picture cards. For some years past the general level of the better lettering and illumination has been slowly rising, though there has still been far too large a proportion of indifferent work, and the setting out of the "private greetings," always a difficult problem, has left a good deal to be desired. This year, however, the improvement in much of the lettering itself, as well as in its spacing and setting out, has been so marked that one has been forced to the conclusion that—patriotism apart—we are justified in thinking that the most unsatisfactory Christmas cards have been made in Germany. It is remarkable what a much smaller number of really tasteless cards seem to have been on the market this year than usual. That does not, of course, mean that all the cards or all the lettering on them has been good, but it does show real progress. Another very hopeful sign is the increasing variety of letter-forms used. Instead of confining themselves to one or two styles, scribes seem to be learning the wisdom of catholicity, and they are now much more willing than formerly to found themselves on any good model they come across, no matter in what century it may have had its origin.

The only unsatisfactory development which has to be noticed this year is in the direction of facsimile handwriting. If people want that kind of thing they must presumably have it; but would it not be possible for the manufacturers to draw the line somewhere, and not offer the public quite such bad examples of facsimile handwriting as some of them put upon the market?

When we turn to type and type-setting there are one or two points worth noting. The Christmas season, though it must have been a bad one for the book trade, brought its usual crop of publishers' announcements. These were in the main very satisfactory pieces of work, and the great majority of them were not only well planned but set out in good type. Further, the employment of old "printers' ornaments" by one or two firms helped to give their notices an air of distinction. Again, since the New Year, one of the best known London daily papers has changed the type of its headlines. The claim is that this has increased their legibility, and it is justified; but it has further, by substituting

a good square type for a thin one, very much improved the appearance of the pages. Little improvements of this kind are an indication of the increased care taken nowadays with regard to lettering, and of the greater estimation in which it is held. It is not so long ago that any sort of type was regarded as good enough for advertisements, newspapers, and the like.

Embroidery, Eastern and Western.—Within the last few years English needlewomen have shown a distinct tendency to turn their attention towards cross-stitch, tent-stitch, plait-stitch, and other types of embroidery which take their character in large measure from the square mesh of the material on which they are worked. This is a state of affairs which some embroideresses exult in and others condemn. It seems as though in truth it has both its bad and its good side. It inculcates habits of accuracy, but it also tends sometimes to encourage the love of a rather niggling style of work. Further, the most ardent advocate of the system of designing freely with the needle would hardly urge a Western workwoman to begin work which must of necessity be done by the thread without having carefully planned the main lines of her design, and needlewomen who do this kind of work commonly look about for a model to adapt or more often to copy. Unfortunately the examples most easily accessible to most people are just those least worth copying, and the result is that a good deal of the modern canvas-stitch work of all kinds is very dull and spiritless. The little collection of old embroideries from the Greek Islands and Turkey now on view at the Burlington Fine Arts Club ought to give such workers just the kind of direction they need. The designs on the whole are so vigorous and full of "go," the cross-stitch and other birds and beasts are so quaint and yet so alive, the conventional patterns so well balanced that the needlewoman who found no inspiration in them would be dull indeed. To the student concerned with the history of embroidery and the relation of the work produced in one country to that to be found in another, the exhibition has an added interest. It knocks yet another nail into the coffin of the old idea of "Crete embroidery," and it makes it apparent that there is a more direct connection than is sometimes allowed for between the work executed in the Greek Islands and that which comes from those parts of Italy which in old days were in close touch with the East.

CORRESPONDENCE.

THE INDIAN INDIGO INDUSTRY.

Chinese Alkaline Extraction Vat.

In continuation of my letter published in the last issue of the *Journal*, I should like to add a few remarks about this method of extraction, an account of which I read in a Bulletin issued and written by (if I remember rightly) the Superintendent of the Botanical Gardens, Singapore. It is now out of print, but as the Chinese method is the opposite of the Behar method an allusion to it may be of interest.

The author mentioned that the Chinese put lime along with the plant into their steeping vats, and, after extracting the dye, often replanted the steeped plants.

This indigo, I believe, is, or was, used locally by the Chinese in the Malay States, and exported to China, but never found its way to other markets. I think this alkaline method of extraction may be worthy of experiments.

It is interesting here to note that the alkaline vat is now used by our British and, I believe, German dyers in preference to the acid fermentation method of reducing indigo blue to indigo white, as the latter method was capricious and wasteful.

It seems to me that the alkaline method of extraction should be tried in Behar, using, perhaps, ammonia gas (more suitable than lime) to maintain the vat liquor throughout the steeping in a faintly alkaline, or perhaps simply neutral, condition, but here again we want the advice of the best British scientific brains.

Japanese Natural Indigo Industry.

There is, or was up to a few years ago, a small natural indigo industry in Japan, but I do not know what method of extraction they employed. I was informed that they made extensive trials of the natural dye and synthetic indigotin during their war with Russia, and that the results were in favour of the former.

With regard to Professor Henry E. Armstrong's most interesting article on "The Future of Indigo," which appeared in the *Journal* of the 8th inst., I should like to say simply that we planters trusted entirely to our late scientific advisers in India, and when they told us the margin for improvement was limited to 15 per cent. we accepted their statements in good faith, and came to the conclusion that there was no scope for further improvements in manufacture. I ask, in fairness to the planters, Are we to be blamed if we, after repeated losing seasons, decided to reduce or discontinue entirely our cultivation of indigo and efforts in further research work in this department of our industry?

LEWIS J. E. HAY,
Retired Behar Indigo Planter.

BRITAIN AND GERMANY IN RELATION TO THE CHEMICAL TRADE.

I have read Dr. Ormandy's paper on "Britain and Germany in Relation to the Chemical Trade" with a great deal of interest. I have been connected with the coal-tar industry for nearly fifty years, but no doubt we as manufacturers have allowed Germany to wrest from us much of the trade which we ought to have maintained. It has been due not to our own fault, but rather to

the fault of successive Governments, who have not only ignored us but have fostered German industries by buying from them to our detriment. In my own branch we have been undersold by German competitors simply because the German Government subsidised their own manufacturers, whilst no British Government has held out a helping hand to assist us. Our patent laws have been interpreted to our disadvantage. It is not the manufacturer who is to blame, but the Governments who have failed to help him.

R. LE NEVE FOSTER

OBITUARY.

SIR OWEN ROBERTS, M.A., D.C.L., LL.D.—By the death of Sir Owen Roberts, which occurred on the 6th inst. at his house, Henley Park, near Guildford, the Society has lost one of its staunchest supporters and one of its most valued members. Elected in 1879, he became one of the Society's Treasurers in 1880, and from that date to the present time he has served on the Council with one solitary interval of a year. On five occasions he filled the office of Treasurer, in each case for the full term of five years, except on the last occasion when his tenure of office was interrupted by his election as Chairman of the Council. This post he only held for a single year in consequence of his dislike to the delivery of a second address, a duty the nature of which was always irksome to him. In the intervals between his various treasurerships he served as one of the Vice-Presidents. Such a record of service, extending over an almost unbroken period of more than thirty-four years, is absolutely unique in the Society's history. The value of his services it is really difficult to overestimate. His influence secured a large amount of financial help from the City Companies and from individuals, while his able management of the Society's finances contributed largely to its present prosperity.

He was born in Carnarvon in 1835, and on leaving school he became a scholar of Jesus College, Oxford, of which college later in life he was made an Honorary Fellow. In 1865 he was called to the Bar, but he never practised, and for some time he held a clerkship in the War Office. This post he gave up in 1866 to become Assistant Clerk to the Clothworkers' Company, in preparation for his appointment as Clerk in the following year. Here he found the work of his life, for he held the office till 1907, when he was elected Warden on his resignation, and two years later he was paid the very considerable compliment of being elected Master of the Company in recognition of his services.

When he first took office the City Companies were not in high repute. They were wealthy, and had the credit of being wealthier, and they were accused of devoting their funds to their own purposes while neglecting the trades for whose benefit they had been founded. It was admitted that they were liberal and judicious administrators of large charitable funds, but there was a considerable popular demand for their wholesale abolition, and for the application to public purposes of their large resources. This is not the place to discuss the truth of the accusations or the justice of the demands. The matter is mentioned only because it was the life work of Owen Roberts to rescue the great City Companies from the contumely with which they were overlaid, and to secure the judicious administration of their surplus funds for purposes of education and scientific research. The whole credit must not be assigned to him—he had able and zealous coadjutors. It cannot be stated for certain that he was the first to conceive the idea of devoting City funds to technical education, but he surely was the first to realise the importance of the work, to perceive that there was a great public purpose to be effected, and that the salvation of the ancient City Companies lay in taking up the duty of effecting it. How the old Trade Guilds of the City of London could again assume the duties which for centuries they had allowed to lapse was a very difficult problem. It was solved by the decision that they should form an organisation to provide for what it was at the time believed to be the greatest industrial want in this country—the want of scientific training for its industrial workers. Hence was developed the scheme for the encouragement of technical education, of which Owen Roberts was the most earnest promoter and the most zealous advocate.

Among those who co-operated with Roberts may fairly be mentioned two other clerks of City Companies, Sir William Sawyer of the Drapers and Sir John Watney of the Mercers, with Sir Frederick Bramwell the Prime Warden of the Goldsmiths. These and many others worked earnestly on behalf of technical education, but it must always be remembered that the man who helped most to initiate the movement and who contributed the driving-power for its successful development was Owen Roberts. The history of the movement, which commenced in 1877 with the formation of a committee of representatives from twelve of the Livery Companies and resulted in the establishment of the City and Guilds Institute, cannot be recorded here; suffice it to say that Sir Owen Roberts devoted to its development and organisation the same constant and earnest care that he gave to its foundation, and that in the last years of his life, when he was an active member of its council, and the chairman of one of its most important committees, he was as keen a worker on its behalf as during the earlier years when he acted as one of its three honorary secretaries.

Nor were his exertions in promotion of technical education confined to London. At his instance the Clothworkers' Company evoted large sums of

money to the provision of textile industries and dyeing departments at the Yorkshire College, which eventually developed into the University of Leeds, and also liberally assisted other technical education institutions in various parts of the country. Nor was it merely that ample funds were provided for the foundation of lectures and the equipment of laboratories. Care was always taken that those funds were carefully utilised and judiciously applied. Roberts's shrewd business instincts and financial capacity ensured this, and he also possessed a singular capacity for estimating the value of other men's work, and getting the best results out of those with whom he co-operated. Consequently his advice was always sought and readily followed.

If, however, it was in connection with the industrial applications of education that he was best known to the public, he was perhaps really more attracted to the promotion of female education, and in this he took a keen personal interest. He was one of the promoters of Somerville College, Oxford, and always took a great interest in its welfare.

But educational matters alone by no means absorbed all his available energy. If he was not the first to suggest a practical scheme for the amalgamation and utilisation of the parochial charities of London, he certainly took an early and important part in the consolidation of the large funds belonging to the parishes and to various old Trusts in the City of London, which had certainly been to a very large extent wasted. The result was the formation in 1891 (under an Act of 1883) of a central governing body—the City of London Parochial Charities Trust—and into their hands was given the administration of these funds, amounting to a very large annual sum, over £100,000, which is now judiciously administered for various charitable and educational purposes. These purposes include the maintenance of City churches, the support of polytechnics and of technical education generally, the provision of open spaces, grants of pensions, and similar objects. Although at the time of its introduction the scheme met with a good deal of opposition from vested interests in the City, it has long since been admitted to be a useful and valuable reform. Sir Owen Roberts was the first vice-chairman of the Board of Governors, and the first chairman of its Estates Committee. Both of these offices he held until his death, and he exerted a potent influence over the work of the Trust.

In addition to all the work he did of a public nature, he found time to take part in the administration of various commercial companies. He was a director of several important insurance companies, of the Improved Industrial Dwellings Company (a semi-philanthropic institution which turned out a sound business undertaking), of the City of London Real Property Company, and of certain others.

The various bodies, educational and other, with which he was associated, and in the direction of which he took part, were very numerous. He took an active part in the reconstitution, under a scheme of the Charity Commissioners, of the old City Foundation established in 1710 by Sir John Cass, with its schools and technical institute, of which he became the Chairman. He was also for fifteen years chairman of the Central Foundation School associated with the name of the Rev. Prebendary Rogers, and for eleven years he acted on the Technical Education Board of the London County Council. He was also for some time chairman of the London Polytechnic Council. He served on the Commission for the reconstruction of the University of London on a teaching basis, and was for six years a member of the senate of that University. He was a member of the Council of King's College, of the Council for the Extension of University Training, and of the Governing Body of the Imperial College of Science and Technology. At the time of his death he was a member of the committee of the Athenæum Club, and for some years he was Treasurer of the Society of Antiquaries.

He was knighted in 1888. He was three times married. Lady Roberts, who survives him, is a daughter of the late Mr. John Chadwick, of Stockport. By his first wife he had one daughter, who is married to Dr. Robert Armstrong-Jones. By his second wife he had two daughters, the elder of whom is married to Mr. William H. Davison, the present Mayor of Kensington, and one of the Treasurers of the Society, while the younger, who died some years ago, was married to a son of the late Sir Ralph Knox, K.C.B.

He was one of his Majesty's Lieutenants for the City of London, and was a Deputy-Lieutenant for the County of London and the County of Carnarvon, of which he was High Sheriff in 1908. He was a Justice of the Peace for the counties of London, Surrey, and Carnarvon.

As may be judged from the above summary of his various interests, Owen Roberts was a man of the shrewdest judgment and singularly astute. His financial capacity was remarkable, and his intellect of the quickest. He made no pretence to scientific knowledge, or to literary power, but his opinions on political, social, scientific and literary matters, if quickly formed and promptly expressed, were sound and judicious, always moderate, never extreme, but uniformly sensible. Gifted with the warmest heart and the most affectionate nature, he had numerous friends who appreciated his many charming qualities and loved him for his genial disposition. It seemed to be ever a pleasure to him if he could do anything to promote a friend's welfare, or further his objects, and to this end he would spare no pains. Many went to him for counsel and advice, and he was ever ready with both. The busiest of men, he always had time to help those who wanted help, and he reaped his reward in the affectionate regard of the large circle of friends who now mourn his loss.

GENERAL NOTES.

New Route from Petrograd to London.—It is stated in the *Corriera della Sera*, of Milan, that a new route from Petrograd to England will shortly be available for traffic. From this it appears that the construction of a short line which will connect the railway system with that of Sweden is being pushed rapidly forward. This missing link, which is only 20 kilometres (12½ English miles) in length, will connect Tornea, the present terminus of the lines in Finland, at the northern extremity of the Gulf of Bothnia, with the Swedish network at Karunga. From this place passengers can reach Bergen (Norway) by rail, without change, and travel thence by sea to Aberdeen. It is expected that the journey from Petrograd to London will not occupy more than 5½ days.

Bank Dividends.—The directors of the London County and Westminster Bank, Limited, after making provision for bad and doubtful debts, and applying £336,000 in writing down investments, have declared a dividend of 10⅝ per cent. for the past half-year (less income tax), making a total distribution of 21¼ per cent. for the year 1914. The directors of the London City and Midland Bank, Limited, recommend a dividend for the last six months at the rate of 18 per cent. per annum, less income tax. The dividend for the year 1913 was at the same rate. The net profits of the Union of London and Smiths Bank, Limited, for the past half-year, after payment of all charges and making provision for all bad and doubtful debts, amount to £280,682, to which has to be added £232,372 brought forward, making a total of £513,055. The directors recommend a dividend at the rate of 10 per cent. per annum, subject to income tax. The directors of the London Joint Stock Bank, Limited, report that the net profits for the past year, including £62,326 brought forward, amount to £515,500. Of this sum £163,350 was absorbed by payment of the interim dividend in July last, and the balance they dispose of as follows: £100,000 as provision for any further depreciation in the value of securities; £163,350 in payment of a final dividend of 16*s*. 6*d*. per share, being at the rate of 11 per cent. per annum (less income tax) for the past half-year, the balance of £88,800 being carried forward. The directors of the London and South Western Bank, Limited, recommend a final dividend for the year at the rate of 16 per cent. per annum, less income tax, and that the balance of £72,291, compared with £57,600 in 1913, be carried forward. In July an interim dividend at the rate of 18 per cent. was paid, thus making a total dividend for the year of 17 per cent. The directors of Messrs. Barclay and Co. have declared out of the profits for the half-year ended December 31st, an interim dividend of 4*s*. per share, being at the rate of 10 per cent. per annum on the "A" shares; and 7*s*. per share, being at the rate of 17½ per cent. per annum on the "B" shares, subject in each case to deduction of income tax. The interim dividend will be payable on and after February 1st to those shareholders whose names were registered in the books of the company on the night of December 31st last. The directors of Lloyds Bank, Limited, have declared an interim dividend of 14*s*. 6*d*. per share, being at the rate of 18⅛ per cent. per annum. The directors of the Capital and Counties Bank, Ltd., have declared an interim dividend for the past six months at the rate of 14 per cent. per annum. The directors of Williams Deacon's Bank, Limited, have declared a dividend for the half-year ended December 31st last at the rate of 14 per cent. per annum, less income tax.

The Manufacture of Thymol.—The *Times* draws attention to the fact that hitherto the manufacture of the well-known antiseptic, thymol, has been practically confined to Germany, notwithstanding the fact that ajowan seeds, the oil from which is almost the sole source of commercial thymol, are grown on a large scale only in India. No further supplies of thymol being forthcoming from Germany, owing to the war, the price had increased almost eightfold by September last, and is even now 21*s*. 6*d*. per lb. as against 5*s*. per lb. before the war. There is no reason why the United Kingdom should not become the chief centre for the manufacture of thymol. The manufacturing process is quite simple, and ample supplies of ajowan seed are available in India. The Imperial Institute, which has devoted attention to this subject, has made inquiries in India, and is prepared to put intending British manufacturers of thymol in touch with Indian exporters of the seed. Fortunately, too, a British Possession can provide a substitute for thymol if such be required. This substance is carvacrol, which is obtained from oils derived from a variety of plants, but particularly from the origanum of Cyprus. At the instance of the Imperial Institute this Cyprus origanum oil is already being produced in commercial quantities from wild plants in Cyprus, and in 1913 was exported thence to the United Kingdom to the value of £980. It is believed that the plant can be cultivated profitably and on a large scale in Cyprus, and experiments in this direction are understood to have been begun.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock:—

January 20.—J. A. Hunter, "The Textile Industries of Great Britain and of Germany." Lord Rotherham, President of the Textile Institute, will preside.

January 27.—Hon. John Collier, R.O.I., "Portrait Painting." Lord Sanderson, G.C.B., K.C.M.G., will preside.

February 3. — Octavius Charles Beale, Chairman of the Australian Manufacturers'

Association, "Imperial Industrial Development after the War." George R. Parkin, C.M.G., LL.D., D.C.L., Organising Secretary of the Rhodes Scholarship Trust, will preside.

February 10.—F. Vincent Brooks, "British Lithography in 1915."

February 17.—Arthur Wilcock, "Decorative Textiles, and the Designer's Relation to the Industry."

February 24.—W. J. Ashley, M.A., M.Com., Ph.D., Professor of Commerce in the University of Birmingham, "The Economics of the War."

March 3.—William Poel, "Shakespeare's Profession."

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

January 21.—Henry John Elwes, F.R.S., "Nepal." The Right Hon. Sir Herbert Maxwell, Bt., F.R.S., will preside.

February 11.—Captain Sir George Duff Dunbar, Bt., I.A., "Tribes of the Brahmaputra Valley." Lieut.-Colonel Sir Francis Younghusband, K.C.I.E., LL.D., D.Sc., will preside.

March 18.—Lieut.-Colonel A. C. Yate, I.A. (retired), "The Indian Army."

April 15.—M. M. S. Gubbay, I.C.S., "Indian Trade and the War."

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

January 26.—Major E. H. M. Leggett, R.E., D.S.O., Managing Director of the British East Africa Corporation, "The Economic Development of British East Africa and Uganda."

February 2.—Edward R. Davson, "Sugar and the War."

May 4.—S. Chas. Phillips, M.S.C.I., "The Empire's Resources in Paper-making Materials."

Dates to be hereafter announced:—

Thomas Worthington, "The Work of the Commercial Intelligence Branch of the Board of Trade."

T. Thorne Baker, "The Industrial Uses of Radium."

Frank Baines, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

J. W. Gordon, "Patent Law Reform and the War."

E. W. Hulme, "Patent Law."

H. M. Thornton, "The Industrial Uses of Coal Gas."

D. Y. Cameron, A.R.A., R.E., "Etching."

Roger Fry, "Post Impressionism in Design."

C. H. Sherrill, "Ancient Stained Glass."

A. S. E. Ackermann, B.Sc., Assoc.M.Inst.C.E., "The Utilisation of Solar Energy."

Lady Lugard, "The Work of the War Refugees' Committee."

Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

Indian Section.

Thursday afternoon, at 4.30 o'clock:—

May 13.

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

March 2, 30.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

F. Mollwo Perkin, Ph.D., F.I.C., F.C.S., M.Inst.P.Tech., "Oils, their Production and Manufacture." Three Lectures.

Syllabus.

Lecture I.—January 18.—Mineral oils—Historical — Their sources — Oil-fields and their distribution — The production and refining of natural mineral oils—The shale-oil industry and its possibilities.

Lecture II. — January 25. — Low temperature carbonisation—cracking of oils—Motor spirit—Fuel oils.

Lecture III.—February 1.—Vegetable oils—Raw materials—Sources of supply—Methods of manufacture—Methods of refining—Edible oils—Paint oils.

M. H. Baillie Scott, "House Building—Past and Present." Three Lectures.

March 15, 22, 29.

David Sommerville, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

Fothergill Lectures.

Monday evenings, at 8 o'clock:—

Professor Vivian B. Lewes, F.I.C., F.C.S., "Motor Fuel." Three Lectures.

February 15, 22, March 1.

MEETINGS FOR THE ENSUING WEEK.

Monday, January 18...Royal Society of Arts, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Dr. F. Mollwo Perkin, "Oils, their Production and Manufacture." (Lecture I.)

Victoria Institute, 1, Central Building, Westminster, S.W., 4.30 p.m. Rev. Canon E. M'Clure, "Modernism and Traditional Christianity."

Electrical Engineers, Institution of (Local Section), Mining Institute, Newcastle, 7.30 p.m. Mr. E. B. Wedmore, "Automatic Protective Switchgear for Alternating-current Systems."

East India Association, Caxton Hall, Westminster, S.W., 4 p.m. Mr. E. A. Molony, "Wells for Irrigation in India."

British Architects, Royal Institute of, 9, Conduit-street, W., 8 p.m. Mr. F. C. Eden, "Ecclesiastical Buildings of Northern Italy."

Engineers, Cleveland Institution of, Corporation-road, Middlesbrough, 7.30 p.m. Mr. V. Stobie, "The Manufacture of Electric Steels in the Stobie Furnace."

British Decorators, Institute of, Painters' Hall, Little Trinity-lane, E.C., 8 p.m. Mr. R. H. Vigor, "Scaffolding."

TUESDAY, JANUARY 19..Statistical Society, 9, Adelphi-terrace, W.C., 5.15 p.m. Professor S. J. Chapman and Mr. D. Kemp, "The War and the Textile Industries."

Illuminating Engineering Society, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Discussion on Some Points in connection with the Scientific Development and Practical Applications of Searchlights.

Royal Institution, Albemarle-street, W., 3 p.m. Professor C. S. Sherrington, "Muscle in the Service of Nerves." (Lecture I.)

Photographic Society, 35, Russell-square, W.C., 8 p.m. Mr. R. A. Mallby, "The Production of Lantern-slides of Great Transparency, and the Tinting of them with Colours also Transparent."

Engineers and Shipbuilders in Scotland, Institution of, 39, Elmbank crescent, Glasgow, 8 p.m.

WEDNESDAY, JANUARY 20..ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. J. A. Hunter, "The Textile Industries of Great Britain and of Germany."

Meteorological Society, at the Surveyors' Institution, Great George-street, S.W., 7.30 p.m. 1. Annual General Meeting. 2. Account of the Proposed Climatological Atlas of the British Isles."

Optical Society, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 8 p.m. The Thomas Young Oration will be delivered by Sir James Crichton-Browne.

Entomological Society, 11, Chandos-street, W., 8 p.m. Annual Meeting.

Microscopical Society, 20, Hanover-square, W., 8 p.m. Dr. C. Singer, "Notes on the History of the Microscope."

THURSDAY, JANUARY 21 ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4.30 p.m. (Indian Section.) Mr. H. J. Elwes, "Nepal."

Petroleum Technologists, Institution of, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. E. H. C. Craig, "The Prospective Oilfields of Western Canada."

Royal Society, Burlington House, W., 4.30 p.m.

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Linnean Society, Burlington House, W., 5 p.m. 1. Miss Ruth C. Bamber, "Report on the Fishes collected by Mr. Cyril Crossland in the Sudan." 2. Professor W. J. Dakin, "Narrative of his recent visit to the Houtman Abrolhos Archipelago, West Australia."

Chemical Society, Burlington House, W., 8.30 p.m. 1. Mr. H. Krall, (*a*) "Guanidine. Part II.—Copper Derivatives", (*b*) "Guanidine. Part III.—Potassium Derivatives"; (*c*) "Guanidine. Part IV.—Silver Derivatives and Constitution." 2. Mr. G. K. Kolhatkar, "Studies on Alcoholysis. Part I.—Dilatometric determination of the velocity of alcoholysis in the presence of a large excess of alcohol." 3. Mr. B. Lambert, "The Wet Oxidation of Metals. Part IV.—The Question of Passivity." 4. Mr. A. R. Normand, "The Velocity of Ionisation at Low Temperatures." 5. Messrs. A. Lamble and W. C. McC. Lewis, "Studies in Catalysis. Part II.—The Inversion of Cane Sugar." 6. Mr. H. King, "The Synthesis of p-thiol-β-phenylethylamine." 7. Mr. P. C. Rây, "Nitrites of the Sulphonium Series. Trimethyl- and triethyl sulphonium nitrites." 8. Messrs. E. C. C. Baly and R. E. V. Hampson, "The Constitution of the Aminoazo Compounds." 9. Mr. S. F. Acree, "On the reactions of both the ions and molecules of acids, bases and salts. A reinterpretation of the reactions of sodium methylate and sodium ethylate with 1, 2-dinitro benzene, 1, 2, 4-dinitrochlorbenzene and 1, 2, 4-dinitrobrombenzene." 10. Messrs. H. C. Robertson and S. F. Acree, (*a*) "On the reactions of both the ions and the molecules of acids, bases and salts. The reactions of sodium ethylate with methyl iodide in absolute ethyl alcohol at 25°"; (*b*) "On the reactions of both the ions and the molecules of acids, bases and salts. On the conductivity and ionisation of sodium ethylate, potassium ethylate, lithium ethylate, sodium phenolate, potassium phenolate, lithium phenolate, sodium phenythiourazole, sodium iodide, sodium bromide, and mixtures of these electrolytes in absolute ethyl alcohol at 0°, 25° and 35°." 11. Messrs. E. K. Marshall and S. F. Acree, "On the reactions of both the ions and the molecules of acids, bases and salts. The reaction of sodium ethylate with ethyl bromide and ethyl iodide in absolute ethyl alcohol at 25°." 12. Messrs. A. G. Perkin and E. R. Watson, "Addition of auxochromes in the flavone group."

University of London, University College, Gower-street, W.C., 5.30 p.m. Monsieur C. Poupeye, "Belgian Art. Lecture I.—Architecture."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. H. G. Plimmer, "Modern Theories and Methods in Medicine." (Lecture I.)

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Dr. T. C. Worsfold, "Constantinople and the Balkans from my Camera, with Scenes from the recent War between Turkey and the Balkan States"

Historical Society, 22, Russell-square, W.C., 5 p.m., Dr. G. W. Prothero, "The Causes of the Anglo-German Hostilities in 1914 from the Historian's Point of View."

Concrete Institute, 296, Vauxhall Bridge-road, S.W., 7.30 p.m. Mr. E. S. Andrews, "Some Modern Methods of Arch Calculation."

Mining and Metallurgy, Institution of, at the Geological Society, Burlington House, W., 8 p.m.

FRIDAY, JANUARY 22...Chadwick Public Lecture, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 5.15 p.m. Dr. F. M. Sandwith, "War and Disease." (Lecture II.)

Royal Institution, Albemarle-street, W., 9 p.m. Professor Sir James Dewar, "Problems of Hydrogen and the Rare Gases."

Physical Society, Imperial College of Science, South Kensington, S.W., 5 p.m. 1. Dr. A. Russell, "Practical Harmonic Analysis." 2. Mr. T. Smith, "Measuring the Focal Length of a Photographic Lens."

Mechanical Engineers, Institution of, Storey's-gate, Westminster, S.W., 8 p.m. Mr. J. Dewrance, "Standardisation of Pipe Flanges and Flanged Fittings."

SATURDAY, JANUARY 23...Royal Institution, Albemarle-street, W., 3 p.m. Dr. R. T. Glazebrook, "Aerial Navigation—Scientific Principles." (Lecture I.)

Journal of the Royal Society of Arts.

No. 3,244. VOL. LXIII.

FRIDAY, JANUARY 22, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, JANUARY 25th, 8 p.m. (Cantor Lecture.) F. MOLLWO PERKIN, Ph.D., F.I.C., F.C.S., M.Inst.P.Tech., "Oils, their Production and Manufacture." (Lecture II.)

TUESDAY, JANUARY 26th, 4.30 p.m. (Colonial Section.) MAJOR E. H. M. LEGGETT, R.E., D.S.O., Managing Director of the British East Africa Corporation, "The Economic Development of British East Africa and Uganda." SIR OWEN PHILIPPS, K.C.M.G., will preside.

WEDNESDAY, JANUARY 27th, 8 p.m. (Ordinary Meeting.) HON. JOHN COLLIER, R.O.I., "Portrait Painting—the Technique of the Great Masters" LORD SANDERSON, G.C.B., K.C.M.G., will preside.

Further particulars of the Society's meetings will be found at the end of this number.

INDIAN SECTION.

Thursday afternoon, January 21st; The RIGHT HON. SIR HERBERT MAXWELL, Bt., F.R.S., in the chair. A paper on "Nepal" was read by MR. HENRY JOHN ELWES, F.R.S.

The paper and discussion will be published in a subsequent number of the *Journal*.

LIST OF FELLOWS.

The new edition of the List of Fellows of the Society is now ready, and can be obtained by Fellows on application to the Secretary.

COVERS FOR JOURNALS.

For the convenience of Fellows wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1*s.* 6*d.* each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

SIXTH ORDINARY MEETING.

Wednesday, January 20th, 1915; LORD ROTHERHAM, late President of the Textile Institute, in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Bailey, Hollis Russell, 19, Congress-street, Boston, Massachusetts, U.S.A.

Barnard, George E., Park Estate, St. Lucia, British West Indies.

Brandt, Richard Frederick William, B.A., 5, The Boltons Studios, Fulham-road, S.W.

Cherry, Albert, Venezuela Central Railway, Caracas, Venezuela, S. America.

Cottingham, Walter H., Woolley Hall, Maidenhead, Berks; and The Sherwin-Williams Company, Cleveland, Ohio, U.S.A.

Duke, Sir (Frederick) William, K.C.I.E., C.S.I., 11, North-street, Westminster, S.W.

Harris, William A., A.M.I.Mech.E., St. Lucia Usines and Estates Company, Ltd., Castries, St. Lucia, British West Indies.

Heynes, James Baylis, British Vice-Consul, Messina, Sicily.

Hume, F. Charles, Jun., First National Bank Buildings, Houston, Texas, U.S.A.

Lloyd, Professor John Uri, Phar.M.Ph.D., LL.D., 3901, Clifton-avenue, Cincinnati, Ohio, U.S.A.

Lovett, Major-General Beresford, C.B., C.S.I., 59, Madeley-road, Ealing, W.

Morgan, Edward D., 170, Summer-street, Boston, Massachusetts, U.S.A.

Perkin, Dr. F. Mollwo, F.I.C., F.C.S., 199, Piccadilly, W.

Powell, Christopher Charles, 52, Langdon Park-road, Highgate, N.

Power, John Joseph, K.C., M.A., LL.M., D.C.L., P.O. Box 532, Halifax, Nova Scotia, Canada.

Shaw, George L., Antung, Manchuria, China.

Watson, F. Mackman, "Selwood," Rotherham.

Wood, George, 626, Chestnut-street, Philadelphia, U.S.A.

The following candidate was balloted for and duly elected a Fellow of the Society:—

Meriwether, Hunter M., 3616, Gladstone Boulevard, Kansas City, Missouri, U.S.A.

The paper read was—

THE TEXTILE INDUSTRIES OF GREAT BRITAIN AND OF GERMANY.

By J. A. Hunter.

It seems desirable at the outset to disclaim any kind of title to speak with the voice of final authority upon the thousands of nice points which are, in the last resort, involved in a comparison of British with German textile industry. Those matters far transcend any individual experience, for what we speak of comprehensively as textile industry is not actually a single thing, but a congeries of industries differing in themselves and between themselves. Remarkable differences of method, material and machines occur within single branches of the industry within our own country, and many more when a second country is brought into review. It will be possible only to deal with the broader aspects, tracing similarities where they occur and pointing out some salient dissimilarities. In proceeding to that task and illustrating the matter here and there with specific examples, I should like it to be understood that, *mutatis mutandis*, the illustrations given would apply to some other cases than those expressly named. In this country, as one need not say, there are divisions within the industry corresponding with the materials worked—cotton, wool, silk, linen and jute; divisions also corresponding with the class of work done—spinning, weaving and finishing. Structurally, the industry is much the same in Germany as in this country. Concerns are organised to do nothing but spin, or nothing but weave, in both countries, and in both alike sub-division is carried further in some directions than in others, leaving mills in special branches of business fully self-contained. In those respects there are no highly significant differences, the one fact claiming passing attention being that there remains in some parts of Germany a cottage-weaving industry of which we have no exact counterpart. In addition to the fairly numerous hand-loom workers engaged upon costly silks, there were recently some 7,000 hand-looms in Upper Franconia, Bavaria, weaving cheap and coarse mixed woollens for export. Such a survival is only possible where low wages are the rule. In the silk trade hand-looms are more numerous than in this country, but then the whole German silk industry is on a larger scale. In both countries hand-looms are a diminishing quantity in the silk trade, and are being replaced by power-looms electrically driven. In the German silk trade the standard of efficiency is admittedly high, and it is the habit of some British silk manufacturers owning modern factories to compare their own practice with German practice, which they accept as the standard.

Our textile industries are distributed more or less over the whole country with strong concentration upon certain centres, and with less important seats between; and Germany, with its Rhineland, Saxon and Silesian strongholds, and its sprinkling of minor centres, does not conspicuously differ. The geographical distribution is like the English in that the bunching is most marked in the neighbourhood of coal-fields.

In both, textile industry employs—or did in 1907 employ—substantially the same number of persons, approximately 1,100,000 in Germany and 1,200,000 in this country. This is not, however, to say that the industries are of the same size. The German census of production points to a gross output of £150 millions, where ours tells of an output at least twice as large. The discrepancy is striking, in view of the substantial equality in personnel, but no deductions can be drawn from the bare fact without regard to the composition of the industries.

In their degree all measures of the relative importance of industries in separate countries are defective. The quantity of material consumed, or of goods produced, or the respective capacities of the productive plants, all afford opportunities for error, and make it preferable to consider one point with another in drawing any comparison. The course is not invariably pursued in arguing to support a case, but for the general purposes of illustration it will be preferable to deal with both *pros* and *cons*. There are in the world, according to the International Federation of Cotton Spinners, some 145 million spindles spinning cotton. They are not all moving at the same speed or making yarns of the same fineness, but their number is known with approximate accuracy, so that they afford a limited index to the size of the industry. Of

these spindles some 56 millions are in England and $11\frac{1}{2}$ millions in Germany. Ranking next after the United States with its $31\frac{1}{2}$ millions, Germany occupied the third place in cotton spindleage. England has roughly five times as many spindles as Germany, but the spindles are not alike. The mule, or intermittent spinning machine, is the staple producer in England. The ring frame, or continuous machine, accounts for about half the spindles in Germany. With ring frames, which in this country are used principally for spinning warp, and in Germany are largely used for spinning Indian cotton and waste cotton, the two countries are about equally equipped, with some 4 to 5 million spindles each. Of mule spindles we have approximately ten to the German one, and it is apparent that in England cotton yarn is spun to a much higher average fineness. Per thousand spindles, according to the latest trade figures, British mills consume in a year 77 bales of raw cotton, German mills use 158 bales, or roughly twice as much, indicating that their yarns are more than twice as coarse upon the average. The difference, although considerable, is less violent than between the small Swiss industry, with its consumption of only $70\frac{1}{2}$ bales per 1,000 spindles per annum, and the rudimentary Japanese with its 690 bales. When in 1907 Germany had an outturn of cotton yarn valued at £$31\frac{1}{2}$ millions, our production was returned at £79 millions, or $2\frac{1}{2}$ times as much. With five times as many spindles and three times as many looms as the German, the British cotton industry must be called very much the larger in every respect.

There is a much closer correspondence between the sizes of the respective woollen and worsted industries. Not all the products of the woollen and worsted trades are manufactured into fabrics in this country, and accordingly the comparison cannot be limited to them alone. But when this is done the available data show for the United Kingdom, in 1907, an output of £42·3 millions in fabrics and for Germany £38 millions. The estimates of the total make, based upon the 1907 census, show that England combed nearly twice as much wool as Germany and spun about 20 per cent. more yarn. It is apparent also that England wove some 50 per cent. more length of cloth, 397 million yards against 270. Thus, although the English woollen and worsted industry is materially the larger, there is no such preponderance as in cotton.

The comparison is all in German favour when we come to silk. Where silk employs 32,000 in England, it employs 66,000 in Germany. Five millions sterling covers the gross output of English silk spinning and weaving, while the German industry has an output three times larger (or £14·8 millions) in silk tissues alone, apart from its output of thrown or spun yarn.

The German linen industry, once important, has now some 280,000 spindles, or fewer than half as many as the North of Ireland. It produced 69·9 million lbs. of yarn in the same year as the United Kingdom spun 158 millions.

The German jute industry has expanded of late years to dimensions which have given rise to complaints of over-production. It is, of course, wholly dependent upon Bengal for supplies of raw material, and in the open market it does not compete profitably with Calcutta and Dundee. The German output of jute yarn in 1907 of some 297 million lbs. was nearly three-fourths of the British 417 millions.

Thus in scale Germany has the advantage of us in the silk trade alone; a trade which in our country has for better or worse been exchanged for cotton and wool.

A broad resemblance may be traced in the fact that both England and Germany export something like half their total make; the Germans less than half, and the English more. The gross value of exported British textile manufactures was £176·6 millions in 1912 against the German £72·75 millions. Our export of cotton was £122 millions, theirs was £25·4; our export of wool goods £37·7, theirs £20·6; our export of silks £2·2 against their £11·9. In other words, our immense lead of £100 millions and odd arises in chief from the cotton trade, which has, of course, been built for export purposes, and exports some two-thirds of its production.

Some apology is required for so many figures, but without a few of them the general situation cannot be outlined. The trade of the two countries has not been all in finished goods, nor in the direct sense competitive, and it has been in an important part reciprocal. We have been in the way of sending textile manufactures and apparel to the value of some £$19\frac{1}{2}$ millions to Germany, and of buying £$14\frac{1}{2}$ in return. The two markets have depended on, or made use of, each other, and the industries have been interdependent too. We have been in the habit of supplying German industry with raw material; witness the 8 million lbs. of British wool shipped to that country last year, a quantity independent of the almost twelve times greater volume of colonial wool bought from the London Docks for German consumption.

German industry again has taken off our hands raw by-products generated in course of manufacture in this country. In preparing cotton we accumulate heavy quantities of cotton waste, and the soft or untwisted waste of Lancashire mills has gone extensively to Germany to be treated according to German systems, and to be worked up into soft yarn for machine knitting or weft for cheap flannelettes. When re-manufactured with or without an admixture of Indian cotton, such as Lancashire prefers not to use, some of this waste in the form of yarns and goods comes back to this country. Then in combing wool we remove short fibre, or noil, a by-product not suitable for the uses of worsted manufacturers, but valuable for blankets, tweeds, and various woollen cloths. Germany has been the chief destination for such wool wastes as are not used at home.

The German market, in a word, has been of service in taking these quasi-raw and surplus materials off the hands of the producers, and in realising a better price for them than might else have been obtained. The main operations are not, of course, carried on for the purpose of generating by-products. Wool is combed with the primary object of isolating the long fibre or tops, and of the wool-combing done in this country apparently seven-eighths is for the service of English spinners and the remainder for the use of spinners abroad. We export wool tops, and about one-third of the export quantity has gone latterly to Germany. A more important trade is that in the yarns into which combed wool is spun. Some 45 to 50 million lbs. of worsted yarn, meaning at least one-fourth of all the worsted spun in England has gone normally to Germany, there to be made into cloth, braid, carpets, hosiery, or what not. In worsted yarn of one class the German market has for many years been self-sufficing, spinning substantially all its own merino or botany wool, but relying chiefly upon Bradford for yarns made from cross-bred and British wools, Alpaca and mohair.

If it should appear strange that Germany, with all her industrial energy and ambition, has continued to resort to Yorkshire for nearly one million lbs. a week of certain kinds of worsted yarn, it can be pointed out that the instance does not stand by itself. There are other commodities for which Germany has always come to England, and some for which England has had to send to Germany. As is perhaps usually the case, the explanation of the matter is to be found, not in any single commanding reason, but rather in a complex of reasons. Bradford energies have accepted and followed a particular line, dispensing with everything not found to be indispensable, cutting down every expense to the minimum, and seeking incessantly new ways of making ends meet under the stress of competition. The art of blending long wools together to obtain the desired result at the lowest cost has been mastered thoroughly. The machines to comb the wool and spin the yarn are made upon the spot. The use of the machines can be had upon the most advantageous terms, as the outcome of the division of the trade into separate branches, and the existence of commission combers and spinners. All the apparatus is at hand for dealing with practically unlimited quantities of the given sorts of wool. And so far as investigators have been able to make out, the whole secret of success in this particular direction lies in the pure directness and simplicity of the methods employed. The product has been so necessary hitherto to German weaving manufacturers that a specially low import tariff has applied to yarns of this character, and German orders have provided the whole work of a large number of Yorkshire spinning mills. It may be worth observing that the German worsted industry has fared best with fine wools most nearly resembling those of Saxon and Silesian growth, and that the largest development in this country has been in wools most like those of English growth. "As the twig is bent, the tree is inclined," and it may be that the presence of native supplies of wool of a particular sort gave the respective industries their direction in the first instance.

German worsted spinners—and one might add French and Belgian as well—employ machinery for spinning the finer wools different from that employed in England. They use the intermittent machine or mule where we use the continuous spinning frame. This difference of practice results in a certain dissimilarity of the product. The mule permits a serviceable yarn to be made with less twisting of the fibres than is involved in preparing material for the frame, and thus gives a bulkier and more spongy thread invaluable in producing fabrics of certain types. It allows fibre of a given length of staple to be spun to rather higher numbers than upon the frame, and, by employing suitable wool combs, it is practicable to work without oiling the fibre, a dispensation which has sometimes been said to facilitate the dyeing of fabrics to fine shades, and which spares hosiery manufacturers some trouble in scouring knitted underclothing before sale. Mule-spun worsted

is probably never so durable in wear as the English cap-spun yarn; in some circumstances it is not so easy to weave, and for certain fabrics it is definitely less suitable even in appearance. Within limits the two kinds are interchangeable, but beyond those limits the one does not serve for the other. Often as he has been urged to take up the mule, the English worsted spinner has in general stood by his frames, and the decision may be said to have been dictated by results. Owners of machines of both types have found in their experience the frame to be the more consistently remunerative of the two. And although the last few years have seen a very considerable expansion of plants for spinning fine wools in England, the new machines have been almost exclusively frames. In effect, the available volume of business has been partitioned out, not by any formal or informal agreement between the parties, but by the logic of self-interest. The English have left the mule-spinning of fine wools to the Continentals, and they in return have left the production of frame-spun botany or merino to us. It remains open for anybody to depart from that practice at any time, and there is more present temptation to embark upon mule spinning in England than ever.

There may appear something paradoxical in the facts that while we have supplied Germany with its coarser worsted yarns, we have furnished that country with its finer cotton ones. While we have made the spinning frame our chief producer of worsted, the mule is enormously our chief machine for cotton. As between the two industries—worsted and cotton—and as between the two countries—England and Germany—the positions are almost exactly reversed. Cotton being native to neither, no question of the character of native supplies enters into the case, but some historical reflections may be apposite. Comparatively, the German cotton industry is a young one. Until Alsace was arbitrarily included within the Empire in 1871, cotton spinning was a minnow among industries, engaging only 1½ million spindles. It is still true to say that all the cotton spindles of Germany, with all those of France added to them, are fewer than those of the single town of Oldham. In a general way it is every spinner's desire to turn off yarn in coarse numbers, and the coarser the better, for thereby one gets off the greater weight. Ordinarily, the profit of the transaction is not made in the mechanical operation of spinning, prices for which in England are usually cut to a fine point by the excess of supply over demand, but upon the turn of the market—the buying and selling of the material used. There are always processes at work to prevent the coarse spinner from making all the money, but it remains desirable in all cases to get as large a turn-off as one can. In all the young manufacturing countries a beginning is made with the coarse numbers, and only as this line becomes relatively unprofitable are producers driven towards finer yarns, of which the production is necessarily slower and in which the requirements are more exacting. Fortunately for us, Lancashire possesses climatic advantages favourable to the production of the finest and most perfect yarns. And the million lbs. a week of cotton yarn, representing an annual value of £5 millions sent to Germany, consists largely of yarns finer than those that the Germans have found it advantageous to produce for themselves.

Finally, we have sold to Germany piece goods, not in such quantities as before 1879, when Bismarck launched his protective tariff, but to still considerable amounts. Of 76 million yards of cotton piece goods sent in 1913, approximately one-half were grey or undyed goods, on which the tariff is lighter than on coloured cottons. Some of them went for further manufacture—to be bleached, dyed, or printed, or to be embroidered by machine, and in part to be re-exported in this finished state. Facilities for obtaining temporary admission duty free have existed for the benefit of the German finishing industries and, in conjunction with the differential tariff favouring undyed goods, these have been of some appreciable use to them. However, as a customer merely for 2 per cent. of the cotton cloth exported, the importance of the German market does not rank high in the woven cotton trade.

Owing to the difference of scale a business worth a couple of millions per annum means more to British woollen and worsted manufacturers than to the cotton trade. The amount is, roughly, one-tenth by value of the exports of woollen and worsted cloth, and the German purchases have been preponderantly in goods of the highest class with an average value between 5*s.* and 5*s.* 6*d.* a yard. The market has been of especial moment, not to makers of cheap goods, but to firms whose claims to attention are built rather upon supreme excellence than upon advantages of price. Scotch tweeds, Huddersfield fancy worsteds and West of England cloths, corresponding in quality with those chosen by the best English tailors and resembling them

somewhat in design, have been sent for wear in Berlin and the great cities. The similarity in design is not complete, for every country has its own quirks and twists of taste, and our designers, playing up to Continental preferences, have supplied sporting novelties in colours and patterns in which one would not choose deliberately to be seen at home. They are goods in which our manufacturers have established what is called an individual ascendancy; an ascendancy moral in respect of taste and propriety, material in respect of finish and workmanship, and admitted in both respects. The cloths are not all of a fancy character, but flattery in its sincerest form has been applied with some pertinacity to English designs. German, and still more Austrian, firms have been in the way of copying the patterns produced at heavy expense by Scotch and Huddersfield houses, and drastic co-operative measures have been required to suppress the piracy. Protests in Berlin against the passion for English cloth, and petitions from German makers of cheviots praying for Imperial intervention to discountenance the wearing of English clothes, have further attested the position held by these goods in the German market.

It is, of course, inevitable that all trade to Germany in articles having the character of luxury should suffer from the war. The impoverishment of the classes accustomed to choose expensive clothes, the destruction of so large a part of the flower of German aristocracy, and the antipathy towards England and things English, all forbid the expectation of a return, in any circumstances, to the *status in quo*. The larger part of our trade with Germany, being that in semi-manufactures, is destined to suffer in at least the same proportion as the consuming industries. To what extent German textile industries may suffer is uncertain, but the war may conceivably give them a considerable setback, with effects perceptible in years to come. It can cause no surprise to hear mutterings of severer losses to be inflicted upon the British. One of the journals of the German textile trade was declaring a little while ago that the freeing of German industry from all dependence upon England, whether for goods or raw materials, would be the task immediately confronting the country after the war. No doubt efforts to that end will gain a new impetus, but it can, of course, be reflected that such efforts are not novel. Germany has done her best to dispense with English assistance in the past, and it is by no means certain that she will fare any better in the future. It is true that our sendings to Germany have been larger than German sendings to us, but it does not therefore follow that their market is of more importance to us than ours is to them.

It is at least arguable that the main part of the German supplies to the English market are actually the more readily replaced of the two; and that such of them as cannot economically be manufactured in this country can more easily be obtained from alternative sources than can the goods supplied to Germany by us. If, for want of suitable machines, we cannot produce the relatively small quantity of woollen and worsted yarn imported from Germany, there are machines quite equal to the task in France and Belgium. The inability is not admitted, because there are more ways than one in which the supply can be replaced by home industry, but there is this alternative in reserve. The case is similar also in respect of the imported woollen and worsted cloths and dress goods, valued at nearly £1½ millions per annum, which are also of the type made in the countries bordering upon Germany. We can perhaps count on the French for any requisite assistance also in making the home market independent of Germany for silks. Threats of making German industry independent of England in raw materials need dismay us even less. Dependent utterly upon Bengal for raw jute, mainly upon Australia and South Africa for wool, partly upon Bombay and Egypt for cotton, the Germans are in no position to proclaim a boycott, and the menaces issued in moments of exasperation can readily be given their proper value. The imported German goods of most importance to them and to us are German specialities, even as our exports are mainly in British specialities. Of some £7 millions worth of various manufactures of cotton imported from Germany something more than one-fourth is classified officially as piece goods, a heading which conceals the softer, cheaper and more dangerous classes of flannelette, calico printed in German designs, cotton tapestries and some other goods. The greater part of the cotton manufactures has consisted, however, of cotton hosiery and gloves, lace, trimmings and small wares. In part by the force of cheap labour, and still more by ceaseless application for one hundred years, Chemnitz has built up a trading position in the cheaper forms of knitted cottons as solid as any that has been built up in like circumstances in our own country. Again, by the aid of cheap labour and the development of special machines, the

Plauen lace-makers have evolved a German Nottingham which rests unbeaten in its own fields. In these and some other lines an effective monopoly has been erected; others hesitating to engage in bu iness promising little profit to any but the best-placed producers, and preferring to follow and develop some line of their own.

Obviously, this specialisation which has proceeded in both countries, and has differentiated the character of the industries carried on, has its bearing upon what is loosely called the capture of German trade. It is safe to assert that nobody wants business because it is or was German, but only because it is desirable in itself. The fact that the business was German is no evidence of its intrinsic desirability, and is rather even the reverse, implying some probability that the trade is not such as we are best equipped to transact. The capture of trade is spoken of frequently with a glibness which does no justice to the real intricacies of the case. and the person who is aware simply that English and German goods are somehow "made differently" is quite commonly without an adequate sense of what is implied in the act of making. The differences include the class of raw material employed, and it is observable that German and English manufacturers have not been in the way of selecting identically the same qualities of cotton, wool, silk or jute for their several purposes. The choice of material is conditioned by the types of machinery possessed, some being made for fibres of one quality, some for another. In turn the arrangements as to payment made with workpeople hinge jointly upon the class of material and of machine, and it can be said that some of the wage scales in force in England have taken fifty years to construct, and involve a more or less serious strike at every readjustment. Then in a complete factory all the parts are symmetrical and made to fit in with and feed each other, so that in introducing work of a new kind one is possibly disgearing one or two departments in order to accommodate another—granted that the work is of an order which can be done without acquiring new machines. If new machines are needed, the question of their accommodation arises, and for some of the machines requisite to perform German work in the German manner, manufacturers would need to build new mills. Given new and expensive mills, there remains the question first of finding workpeople, and next of training them to unaccustomed tasks. It will not be professed that all these difficulties affect every case, but such are the order of the troubles besetting those who are lightly advised to go about their work in a new manner and are sometimes reproached for not doing so instantly.

In this, as in most matters, there is room for the play of a healthy conservatism. Experience shows certain classes of business to be more desirable than others, and to be, for example, more stable. A manufacturer knows the vicissitudes of his adopted line pretty well; he has the measure of his competitors fairly exactly, and can calculate with some safety from experience. In entering a new field, normally occupied in force by competitors whose position and tactics are little known to him, unknown risks are opened up, and any person of good sense steps into it with some caution. A radical departure is not in practice made until every means has been exhausted to make the existing machinery, assisted perhaps by some auxiliary machines, do the work. Efforts thus far made to lay hold of German trade are not known to have led to heroic measures. The methods have been those rather of adaptation and modification. with a view to producing something so near to the German sample that it can effectively take its place. The process has not been continued long enough to bear all the fruits of which it is capable. The demand for Government goods. on the one hand. and the breakdown of so much general business on the other, have interfered with the development of new types of goods, but notable advances have taken and are taking place, and in view of the experience of the past we can safely look for more of them. So far as it has gone, the temporary cessation of German supplies can be called educative in two directions, causing a certain number of British manufacturers to strain their facilities to produce goods new to them, and causing also a certain number of trade buyers to realise that there are British goods which can, even with advantage, be substituted for purposes for which it had been supposed that only German goods could serve. The instances might have been more numerous had purchases from Germany been larger in the past. At all events, the cases should prove quite numerous enough for the German liking, and when the Germans return to business the occupation of some of their old strongholds by British competitors is a factor they will have to face.

In some of the trades of this country "foreign" competition and "German" competition have been synonymous terms, and the German has been for ever present as a spectre.

Except in special and comparatively unimportant instances this is not true of the textile industry. Their labour is, upon the whole, cheaper than ours, and much cheaper in some instances; their hours are longer than ours, but the evidence negatives the suggestion that they execute their work more cheaply, except in the departments that they have made their own and that have been neglected by us. Figures are less to the point than the common facts of experience, and there are probably no figures purporting to display comparative industrial efficiency which ought to be taken without reserve. The fact that German competition is not the universal bugbear speaks for itself. The small quantity of German goods—specialities apart—imported into this free and open market, and the British lead of 100 millions per annum in exports, give assurance enough that the British industry in its own field occupies a highly superior position. Schultze-Gavernitz, writing twenty years ago, showed that the Saxon and South German cotton spinners employed 5·8 hands per 1,000 spindles. The number has certainly been reduced since, but nothing suggests that it has been reduced to the 2½ to 3½ per 1,000 spindles which is the general rate in Lancashire, where, of course, very much higher wages are paid. The balance is well in the English favour, and extremely little is heard of German cotton yarn in the markets. Mr. Taft's Tariff Board made an effort to tabulate the respective costs of manufacturing wool goods in certain countries. The instances were few in which British and German quotations were obtained for the same fabrics, but in respect of the five worsted samples in which close comparison was made, it was found that the German cost of converting yarn into finished cloth exceeded the British by proportions rising from 24 to 59 per cent., and averaging 43 per cent. all round. The figures were put forward as authentic, and the direction is one in which Yorkshire could be expected to score, although perhaps not thus heavily. On one or two occasions of severe industrial depression in Germany, samples of low woollen goods have appeared in the English market at prices lower than the ordinarily invincible Colne Valley tweed makers could accept, but no considerable consequences have followed upon these brief and infrequent appearances. Carpet manufacturers have made complaint of German dumping. Hosiery yarn spinners have felt the oblique effects of low prices for yarn interchangeable with their own, but in respect of sales at or below cost, the experience of the English textile industry at large is in no sense comparable with that of the steel trade.

Discussion of racial traits, except in so far as they may be revealed in industrial matters, would be outside the scope of this paper. One such may perhaps be found in relation to the machines for which we are indebted to German initiative. German invention has contributed little to the main machinery of textile mills, but there have come from Germany various improved machines for the dyeing and finishing of goods. The machines have come, have functioned duly and sold widely, and yet have commanded few subsequent orders, for the reason that some less elaborate but more direct English mechanician has come upon the scene with a machine of many fewer parts and fittings and capable of still better work than the original. The instance does not stand alone as evidence that the German is not quicker than the Englishman in arriving straight at the essential point. That defect in them has not been remedied by the system of technical education in which the Germans preceded us.

If it be asked whether the German or the English manufacturer shows himself the more enterprising, the answer must have regard to the total size of the industries in the respective countries. Evidently, German enterprise has not led to a larger development than in England. The fact has already been emphasised that the pair have followed somewhat different lines, and this also has to be taken into consideration in drawing any comparison. It is certain that German manufacturers have developed trades which Englishmen have declined, and have worked up business requiring English-made machines and sometimes English materials. It is probably true also that the Germans have followed with more zest the development of certain new processes and certain new textile materials. Those efforts have not been uniformly remunerative, and have not led to any great and striking success in which British industry has not participated to an equal or a greater degree. The Germans may be said to be less shy of far-fetched projects than our own industrialists, but it would be difficult to say in which textile direction their greater venturesomeness has justified itself by results. There are possibly exceptions, but the effect of a large number of inquiries goes to show that, in general, the British textile manufacturer has got the class of business that he wants, and that in his eyes the class carried on by his proximate equal in Germany is in some way less desirable. Thus

one does not find that a spinner able to make a satisfactory return out of relatively coarse yarn has any urgent desire to spin higher numbers; or that the manufacturer with a prosperous trade in cloths of medium construction burns to exchange that line for a trade in goods with very many more threads per inch. Again, the possessor of a fairly steady trade in fancy goods does not necessarily envy the German his more precarious business in articles of a less staple class. The results of war may be to modify some of these valuations, but there is little to suggest that hitherto the German has come off best in the contest of wits.

There is another sense in which the British textile manufacturer has the better end of the stick. His business, as a whole, is done upon more advantageous terms than the German. Credits in general are shorter, producers get along fairly comfortably without the kartels and other mutual interferences which are always being formed and always being dissolved in Germany and Austria. The reason may be that in this country development has been more gradual and natural. The industries have extended, not to exploit artificial opportunities created by legislation, but in response to healthy demand, and this has not invariably been the case in the Protectionist countries.

The inflamed state of public feeling need not preclude mention of one matter for which the English textile industries are patently indebted to German assistance. From the earliest days of which there are records, British weavers have owed something to foreign assistance in the promotion of their export trade. For immediate purposes one need not go back beyond one hundred years. In the early years of the last century foreign merchants, mainly from the Germanic States, began to settle in Manchester, Bradford, Leeds and some other places, to be in immediate touch with the markets whence textiles could be advantageously bought for sale principally in their homeland. The founder of the English house of Rothschild was one of the many who came here upon this errand, and the modern export trade in English textiles grew up largely under foreign hands, and a large part of it is still transacted by heirs and successors whose names bewray their origin. Trading first to the Continent, these merchants and the English ones who profited from their example, extended their operations to all seas. Possessing the knowledge of foreign languages, usages and tastes which the English of the period lacked, they filled an obvious gap in our commercial equipment at a time when the German textile industry was in an embryonic stage. Indisputably they helped British producers to take further advantage of their capacity to manufacture cheaply and largely, and if some familiar charges brought against British traders have no force against textile exporters the credit must in fairness be awarded partly to them. Certainly it cannot be said of British textile shippers that they are reluctant to write or speak foreign languages, or to quote in foreign currency, or to sell cloth by the metre; or that they are anything less than indefatigable in their commercial travelling. In these respects everything has been learned that Germany had to teach.

Remembering that war is compact of uncertainties, and that there are no means of foreseeing the exact situation that will remain when hostilities are ended, anything in the nature of a forecast must be made with diffidence and reserve. One may, however, believe that in all probable circumstances the war will leave unimpaired our real industrial strength – our ability to produce our established products upon the most economical terms. It may be in the power of Germany to cut herself off from our supplies in the future, but that course can hardly be more to her commercial advantage than hitherto, and it cannot be taken without incurring certain penalties affecting her own ability to compete. At least it does not lie within German power to prevent others from taking more of any commodities of which she takes less. Given the ability to produce the most suitable article at the most advantageous price, we shall find a sale for it – if not in Germany, then elsewhere. What holds good upon the one hand, holds also upon the other. So far as German success is founded upon real strength, it can be counted upon to renew itself after the interval, albeit under certain difficulties and after competitors in this and some other countries have gained experience in matching German goods. Labour, it may be, will possibly be dearer in Germany after the war, and taxes conceivably heavier. These influences may be countered by some affecting our own side, and evidently dogmatism upon the point would be wholly out of place. Perhaps upon both sides we may look rather for the change than the extinction of trade, and we may believe that the British industry is financially better able to carry the burdens of war than the German, and is more likely to attach to itself trade hitherto German than is the German industry to carry away business hitherto British.

There are limits to the specifically German trade that we want, and there are influences, other than the political or sentimental, tending to diminish that trade by diverting demand from the articles which cannot be got, and establishing in sale others of which the supplies are procurable. These influences must become more marked as the war wears on and the need for replenishment arises. The duration of the war will in part govern the advantages derived from keeping open shop while the competitor is closed, and its duration, apart from an outcome which can only be called inevitable, must also, for some years after the close, affect German capacity to carry on business. Their own particular trade is of more moment to English manufacturers than is German, and it is for quite other reasons than the prospective effect upon German commerce that our manufacturers exhibit lively interest in the question of when this war will end.

DISCUSSION.

THE CHAIRMAN (Lord Rotherham), in opening the discussion, said he agreed thoroughly with the various arguments and considerations which had been advanced by the author. For instance, Mr. Hunter said that in the production of fine cotton yarns Germany was far behind Great Britain. Our pre-eminence in that class of trade was due very largely to the skill of the operatives who were engaged in it; indeed, there were some who thought that that skill was, in the case of certain families, almost hereditary. He agreed also with the author in regard to the advantage which Lancashire had in the matter of climate so far as the spinning of cotton yarns was concerned. Everybody did not think that the climate of Lancashire was as agreeable as that of some other counties, but for the particular purpose of cotton spinning it had its advantages. Mr. Hunter had said that not only was Germany behind us in the matter of spinning fine cotton yarns, but she was also behind us in the spinning of alpaca and mohair yarns, and bright-haired yarns generally. Germany was a very big buyer of such lustre yarns, and also of the fine cotton yarns; he thought she was a bigger buyer than the statistics of the author indicated, because he believed that many exports from this country, which were destined ultimately for the German market, did not figure in the Board of Trade returns amongst the exports from England to Germany, as they passed through some other country. For instance, a good many such exports passed through Holland, and our exports to Holland would not be nearly as large if it were not for the fact that that was a means of access to some of the German markets. He also agreed that labour was much better remunerated in the English cotton trade than it was in the cotton trade of other European countries, but it must not be supposed that because higher wages were paid therefore the cost of labour as an element in the production of cotton fabrics was proportionately higher. The fact was that labour in this country was, as a rule, much more efficient than it was elsewhere; and it was, from that point of view, possible to pay higher wages to the individual and yet to have a lower labour cost so far as the ultimate production was concerned. He believed that that was so very largely in connection with the cotton trade. The author, in the course of the paper, alleged that it was the desire of cotton spinners as a rule to spin coarse counts rather than fine counts. He (the Chairman) had not noticed himself so keen a desire in the matter of coarseness or fineness of the counts as in the matter of the profit attaching to the production of those yarns. He thought the chief desire was to make a profit, and if a spinner could make more profit by spinning the finer counts than by spinning the coarser counts, or *vice versâ*, he would do so. There was one kind of business which had not been referred to by the author, and which was not altogether foreign to the subject of the paper, namely, the manufacture of artificial silk. That was a trade in which undoubtedly Germany had taken the lead, but he was glad to know that Great Britain had also made substantial progress in that particular trade during the last few years. For one thing, legislation had been a very serious hindrance up to a point, because industrial alcohol was required in that trade, and alcohol, some time ago, whether used industrially or individually, had been subject to a very heavy tax. By a piece of enlightened legislation, however, industrial alcohol had been, under certain conditions, relieved from that tax, and, inasmuch as it was the raw material in the case of the manufacture of artificial silk, that relief gave a much better chance to the artificial silk industry in this country, and the results had redounded very considerably to the advantage of that industry. In the matter of raw materials Great Britain was very much better placed at the present time than Germany. There was an abundance of raw cotton here, whereas in Germany there was a shortage, and in order to supply that shortage there had been a transaction in regard to the transfer of some ships from German ownership to alleged American ownership, and it was intended to send from America some cotton shipments in some of those vessels. The outcome of that would be seen in a few weeks, and he did not wish to say more on that matter, but he thought it was a proof of what he said that Germany was very much more in want of raw cotton than this country was. Then in regard to wool, he believed that British spinners and manufacturers were infinitely better placed than those in Germany. He did not suggest that wool and worsted spinners in this country had as much raw material as they would like, owing to cargoes being hung up in the docks and

round the coast, but there was a veritable famine in Germany in regard to some qualities of wool which were required there. He agreed thoroughly with the suggestion made by the author as to the educative effect of the desire which at present existed to capture German trade, but German trade could not be captured successfully except by the closest study and consideration.

Sir Philip Magnus, M.P., remarked that his only connection with the industry was on account of the interest which he had taken for some thirty-five years in the organisation of technical classes, associated with the textile industries, and in which artisans, employers of labour, managers, and other persons might have the opportunity of studying all the complicated details connected with the industries. With regard to the paper, it breathed a very healthy note. It was extremely encouraging, and showed that, notwithstanding many disadvantages which in the past may have been suffered, there was very little fear of our falling back in the manufacture of the important materials with which the paper dealt. He had been very gratified to gather from the author that the country had not suffered from any want of efficiency on the part of those persons who were employed in the industry. It was pleasant to hear that being said at a time when we were so often told that we were much behind our German competitors in the matter of technical education. It was also very pleasing to hear the Chairman remark that one of the advantages which this country possessed over the Germans was the greater efficiency of the persons employed in the manufacture of textile materials. It was extremely satisfactory to know that in every branch of the textile trade the trade of this country was very much greater than that of Germany, and that it was only in silk that we were behind. He would like the author to say why that was the case. There had never seemed to him (the speaker) to be any real reason why Great Britain should not have as valuable a silk industry as cotton or woollen or any other textile industry. He did not think there was any great reason to fear that, even after the war was over, our textile trade would not continue to hold the same preferential position which it occupied at the present time. During the last few months there had been a considerable depression in all branches of the industry, but that depression had occurred even before the war; it began as early as March or April of last year. It had, of course, been accentuated by the war, but he trusted that Great Britain would be able to capture some portion of the present German trade. The author had correctly stated that the trade between Germany and England in textiles had been mutually advantageous and reciprocal, but there was every possibility that after the war the Germans' love for us would not be increased, and that consequently they would be less willing to trade with England. Even if that were the case, he did not anticipate that there would be any great falling off in the textile trade, because the Germans would then be required to get their supplies from some other country, possibly from America, and in American industry there would be a gap which, he hoped, we should be able to fill up, so that the result would be practically the same to the British industry.

Mr. P. M. Evans (Clerk to the Clothworkers' Company) said that as his Company had done a great deal of work in connection with the University of Leeds, he was very interested to attend and hear the paper. He believed the Textile Industries Department at Leeds was one of the best in the kingdom, if not in the world; and with regard to the Dyeing Department, he believed that a great many of the experiments, or some of the work at any rate, in connection with the big question of aniline dyes had been considered and dealt with in that department. The Clothworkers' Company had been very pleased, by establishing those departments, to help in such an important work.

Mr. Frank Nasmith considered the author had done excellently in compressing the amount of matter he had had to deal with in such a small space. There was one point he desired to raise, without being at all pessimistic about Great Britain, and that was the development of one or two sides of the textile industry in Germany, for instance the development of the electrical side. The Germans had gone very much faster ahead in equipping their mills with electrical driving, and had produced excellent results. A British calico printer told him a short time ago that the British calico printers were absolutely beaten in the matter. The Germans had a system of control of their motors by means of which an exceedingly good regulation was obtained. The operative, although he might not know what he was doing electrically, was able to operate his machine and get such a register that the accuracy and finish of the pattern was really remarkable. With regard to the driving of looms, it had been proved that in this country the individual driving of looms was of material advantage. In his visits to Germany he had noticed that the mills there had been better equipped with electric individual driving than those in Great Britain. He would point out that the German textile industry, or certain sections of it, had been forced to specialise. They had not been able to compete to any considerable extent in connection with what he might call the "bread and butter" side of th trade, but had been forced into other things, and they had developed those departments on such scientific lines that they had beaten us, and we should have to learn something from them. He was speaking particularly of the cotton-waste side of the question. He was very glad to see that there had been a very healthy revival in Lancashire in that matter. One thing had struck him in going

into that question, namely, that the German waste spinners did not always employ waste only, but preferred to use short Asiatic staple, Indian cottons, and so on, which gave a sort of new life to the resultant yarn, and produced a very much finer finish than the ordinary low waste yarns did in this country. There was one curious thing he had discovered when he had been working out a paper for a society in Manchester, namely, that, taking the percentages of exports, he found that Germany's biggest market was our least market and that our least market was Germany's biggest market. He was speaking of the cotton trade. That showed that our markets and Germany's markets were complementary rather than competitive.

On the motion of the CHAIRMAN a hearty vote of thanks was accorded to the author for his interesting and instructive paper, to which Mr. Hunter briefly replied, and the meeting terminated.

REINDEER IN ALASKA.*

The introduction of the European reindeer into Alaska was recommended by Professor S. F. Baird in 1851, notwithstanding the fact that the indigenous American caribou is capable of domestication. This suggestion was also made by Townsend in 1867, and in 1892 Dr. Sheldon Jackson, Agent-General of the Bureau of Education in Alaska, introduced a small herd of domesticated European reindeer, which was followed by others. As a result of breeding, their number now reaches 40,000, and has transformed the native people from hunters and fishermen to herdsmen.

The reindeer indigenous to North America are *Rangifer arcticus* (Barren-ground Caribou), inhabiting the extreme north, and *R. caribou* (Woodland Caribou) in the wooded region south of the former. The latter species differs slightly from that of the old world (*R. tarandus*). Apparently no attempt has been made to domesticate it, though it is fertile when crossed with the domestic reindeer; this character is valuable, since the native species is larger and stronger than the imported species, which appears to show signs of degeneration. The present area of undeveloped land in Alaska that would be suitable for rearing reindeer is estimated at 100,000 square miles, capable of supporting 10 million deer. The most suitable region is north of the Yukon River. The reindeer lichen (*Cladonia rangiferina*) occurs throughout the arctic region of Alaska, in the Seward peninsula, in the tundras of the west, and in the mountains of the Alaska chain and of the Alaska peninsula.

Reindeer do not require shelter; in fact, they require no care beyond watching. Almost half of the present herds are in the Seward peninsula, and the remainder are distributed as far as Point Barrow on the Arctic Ocean in the Alaska peninsula, and to Tanana towards the Yukon River. They belong to Eskimos, Indians, and a few Laplanders; the latter were brought over with the animals by missionaries to teach the care of the reindeer. Some herds belong to the Government. The Alaska Division of the U.S. Bureau of Education, Department of the Interior, looks after all the herds, through the masters of the Government native schools.

In 1911 a hundred carcasses were sent from Norne to Seattle, and sold for 75 cents per lb. Up to the present the Alaska markets have consumed all the reindeer flesh which is produced. A dressed carcass averages about 130 lbs. in weight; the butcher buys the dressed carcasses at about 25 cents per lb. The most suitable age for slaughtering the animals is seven or eight years, *i.e.*, after they have been worked for five or six years. The cows are rarely milked in Alaska; any milk obtained is consumed fresh after dilution with water or as cheese; butter is never made, since the fat has a rancid flavour. There is a heavy loss amongst the young animals, owing to the unscientific method of rearing introduced by the Laplanders and the tundra fires, so that the rate of increase of the reindeer is only half that of herds of cattle.

* Abstract of an article by Levi Chubbuck (Office of Farm Management, Bureau of Plant Industry, U.S. Department of Agriculture) in the *Journal of Heredity*, Vol. V., Washington.

EMPIRE NOTES.

The Canadian Pacific Railway and the War.—The services rendered to the British Army and Navy by the railway and shipping companies of the United Kingdom in the present crisis have been many, but the work of the Canadian Pacific Railway Company has also been of the utmost value to Canada and the Empire, both in the transport of troops and goods and in the placing of their great liners at the service of the Admiralty. The rapidity and smoothness with which the troops were conveyed to the various camps and ports on the line of railway, while the arrangements for the ordinary passenger traffic were but little interfered with, are regarded as a triumph of careful planning and arrangement. But the yet more difficult question of freightage appears to have been met with great skill and with a patriotic disregard of cost and trouble. On the declaration of war, the War Office asked the Canadian Government to supervise the purchase and transport of commissariat supplies from the Dominion for the Expeditionary Force in France. This was undertaken by the Minister of Public Works, who consulted, among others, the President of the C.P.R., who placed at the service of the Minister a special traffic representative and twenty of his staff. So well was their work done, and so expeditiously were the supplies sent to France, amounting to about 120,000 tons of freight, that a

cable was received from England asking the senders to "go slow," as the goods were arriving too fast to be properly handled. Moreover, through the expert knowledge of the Company's officials, vessels were chartered on a minimum charter rate at an average freight for oats at 25 cents per 100 lbs., and for hay at $7·50 per gross ton. Owing to the rise in freights on the Atlantic, a saving of close on 50 per cent. in current commercial rates was thus effected. Further, no charge was made by the Company for the use of their docks by the chartered vessels, and all the goods were warehoused free. In the latter arrangement the Allan Line also co-operated. The efficiency and patriotic spirit evinced by the C.P.R. are worthy of all recognition, and further emphasise the unity of the Empire in all its departments, commercial and industrial, as well as naval and military, in this hour of the nation's need.

The Georgian Bay Islands.—It appears that when the boundaries of Upper and Lower Canada were extended, at the time of Confederation in 1867, the Dominion Government retained control of the islands lying off the coasts of the Great Lakes, and ever since there have been difficulties in regard to the title of the land comprised in these islands. This question, so far as it applies to the Provincial Government of Ontario and the Dominion Government—in relation to the numerous islands and islets of the Georgian Bay in Lake Huron—has now been amicably settled. According to a recent cable advice, "Ontario gets practically all the islands, except the Manitoulin group. The islands have now been found to number between 5,000 and 6,000." The Manitoulin group contains the only islands of any size, Great Manitoulin having an area of 1,600 square miles, and the title to the land of this group will be retained by the Federal Government, just as the title to the lands of the three Prairie Provinces and the "railway belt" of British Columbia is vested in the Federal authority. The full title to the other islets will be vested in the Provincial Government of Ontario. There is no question of administration involved. All the islands, including the Manitoulin group, will continue to form part of Ontario for political and administrative purposes, and will be subject to Provincial as well as Federal laws. The only effect will be that persons acquiring land in the Manitoulin group will have to obtain their title from Ottawa instead of from Toronto. The fact that there are some 6,000 islands and islets in the Georgian Bay of Lake Huron emphasises the enormous area of the Canadian lakes and the magnitude of the Dominion.

The Northern Territory and Mr. David Lindsay.—The visit to London of Mr. David Lindsay, the well-known Australian explorer, who has been identified with the Northern Territory of Australia for the past thirty years, has been availed of by the *British Australasian* for an interview, in which there are several points of interest. In regard to the climate, Mr. Lindsay says that "along the coastal belt, which extends roughly about 100 miles inland, it is rather trying, the atmosphere, owing to the proximity of the sea, and the heavy rainfall, which averages 60 inches a year, being intensely humid. Womenfolk in particular find it very trying and enervating, partly because they cannot get domestic help. But it is a remarkable fact that many white men, who have lived within the coastal belt for years, are still hale and hearty, are able to work hard, and seem likely to die only of old age. So, in spite of its humid climate, the country within the coastal belt is quite healthy. It becomes still more so, quite bracing in fact, the further one recedes from the coast; for, some distance inland, one reaches an immense plateau, which rises gradually from about 200 ft. to 900 and 1,200 ft. Unfortunately the country cannot be said to be well watered, except in the coastal belt: that is partly why it has not been more developed, and is so sparsely peopled. But there is a vast subterranean supply, and plenty of water can be obtained by sinking bores from 100 to 400 ft." Mr. Lindsay regards it as a wonderful pastoral country, which, for its successful settlement, only requires vigorous systematic development, by railways, roads, and ports. Speaking as a member of the Royal Commission appointed by the Federal Government some years ago, he says that among the various railway and other projects recommended was the opening of a new port in the Gulf of Carpentaria at the mouth of the Macarthur River, and a railway thence to the Barkly Tableland to connect with the line to Queensland. These and other suggestions have been adopted by the Government. Mr. Lindsay is of opinion that mining for gold, silver, copper, lead, tin and wolfram, has a good future, if the mines are properly developed and transport facilities are provided. "One of the finest deposits of wolfram in the world," he says, "is known to exist there." "The country," he adds, "is very fertile; cotton grows wild and if properly cultivated should prove very profitable, notwithstanding the high cost of labour. It is really an easy country to develop because of the numerous small ports and rivers; and the absence of high ranges renders access to the interior a simple task. Large herds of buffaloes still roam over the fields and swamps of several of the rivers. These are the descendants of the four or five Indian swamp buffaloes which were turned adrift when the military settlement at Port Essendon was abandoned in 1849. They have thriven marvellously, and though over 100,000 hides have been sent to market, thousands of buffaloes still remain."

Indian Post and Telegraph Department.—The Post and Telegraph Department in India may well be regarded as an unqualified success, as recent returns show. In the Post Office the surplus of £30,000 for 1912-13, has grown to £337,000 in 1913-14, while in the Telegraphs there is also a substantial surplus. These results have

been secured without taking credit for unremunerative post offices, maintained for military and political purposes, or for wireless stations and mobilisation telegraph stores. The charges of the Department are stated to be the smallest in the world, which may be accounted for by the fact that the personnel is composed of the lowest class of natives and that the means of communication are mostly primitive. It is interesting to note that what is termed the V.P.P., or "value-payable parcel" system, has been so developed that goods to any amount can be sent under it. If consigned by rail the invoice is posted as a V.P.P., and the consignee is thus enabled to get delivery of the goods, although he may be miles from any civilised station and in the depths of the jungle. The number of postal articles carried has grown to a total of 69 millions. The "value-payable parcels" aggregated 8½ millions sterling in value, while money orders amounted to 36¾ millions sterling, and the total balance in the Post Office Savings Bank is 15½ millions sterling. The success of this Department is a striking proof of the service which the Imperial Government renders to India, and is one of the incidental reasons of the remarkable display of patriotic feeling which that great Dependency has shown.

OBITUARY.

George Norgate Hooper.—By the death of Mr. G. N. Hooper the Society has lost its very oldest Fellow, since he was elected in the beginning of 1850, and has therefore completed sixty-five years' connection with the Society. Mr. Hooper, who has been an invalid for some time, died on January 12th, at Beckenham, in his ninetieth year.

At an early age he became associated with Messrs. Hooper & Co. (originally Adams & Hooper), the well-known coachbuilding firm, of which his father was the principal partner. The firm had a high reputation for building travelling carriages before the days of railways, and supplied carriages to King William the Fourth, Queen Victoria, and King Edward the Seventh. Mr. Hooper took a deep interest in the technical side of his business, and when he became head of the firm he did very much to improve the status of British coach-building. His leading position in the trade led him to serve as a juror at several international exhibitions. The first occasion was at the Paris Exhibition of 1855, and after the completion of his work he read the Society a paper in December of that year, which was practically a report on the British carriage exhibits at Paris. He acted in a similar capacity at the exhibitions in London 1862, Dublin 1865, and Paris 1867, writing the official report on carriages at the last-mentioned exhibition for the Royal Commission. He reported to the Society on the 1873 Exhibition in London, which, amongst other special subjects, included carriage-building. In 1893 he wrote the article on British carriages for the catalogue of the British Section of the Chicago Exhibition.

His experience in Paris in 1855 led him to see the importance of industrial education, and from that time forward he devoted himself earnestly to its promotion, especially in connection with the carriage-building trade. When the Society, in 1873, established its technological examinations, Mr. Hooper acted as examiner for carriage-building, and when, six years later, the examinations were transferred to the City and Guilds of London Institute, he served in the same capacity for some time.

He was one of the founders, in 1881, of the Institute of British Carriage Manufacturers. He presided at the meeting called to found the institute, and was its president for many years. In connection with this institute and with the Company of Coachmakers, of which he was Master in 1874-5, he did much to promote the training of apprentices and workmen in the carriage-building trade. From 1864 onwards the Coachmakers' Company has offered prizes for drawings, and in later years other prizes were provided by the Company in connection with the trade. Mr. Hooper also did good service to the cause of education generally, and was for nearly eighteen years chairman of the United Westminster Day Schools Committee.

He read a second paper before the Society in March, 1890, which included an account of the carriage exhibits at the Paris Exhibition of 1889. He was a frequent attendant at the Society's meetings, and often took part in the discussions, as well as contributing a good many letters to the *Journal*. His keen interest in technical and educational matters continued almost up to the time of his death, and he was in frequent correspondence with the Secretary of the Society on such subjects.

John Francis Sykes Gooday.—The death of Mr. John Francis Sykes Gooday, from pneumonia, took place on January 16th. The greater part of his life was devoted to the service of the Great Eastern Railway Company. In 1898 he was appointed general manager of the London, Brighton, and South Coast line, but he only retained that position for a year, for in 1899 he returned to his old company, of which he became general manager. This position he continued to occupy till 1910, when on his retirement from active service he was made a director of the company. At the time of his death he was also a director of the London, Brighton, and South Coast Railway Company.

Mr. Gooday received a number of foreign orders, and he was formerly lieutenant-colonel of the Railway Volunteer Staff Corps. He joined the Royal Society of Arts in 1892.

GENERAL NOTES.

"Collegium."—*Collegium*, the official organ of the International Association of Leather Trade Chemists, has hitherto been published in Germany,

and its issue to members resident in Belgium, France, and Great Britain is no longer possible. It has, therefore, been decided to publish an issue in Great Britain during the war, and the first number under the new arrangement has just appeared. It contains, among other contributions, an article by Professor Henry R. Procter, on "The Combination of Acids and Hide Substance," a "Note sur le Dosage de l'azote dans le Cuir," by Professor E. Nihoul, of the University of Liége, a "Note on the Analysis of Cube Gambier," by Mr. H. G. Bennett, and "Photomicrography," by Mr. Alfred Seymour-Jones. The Hon. Editor and Hon. Treasurer of the British Section of the Association is Mr. M. C. Lamb, 176, Tower Bridge Road, London, S.E.

MARKET FOR INDIGO IN CHINA.—The American Consul-General of Shanghai reports that indigo is one of the chief imports into China, Germany having been the principal source of supply for about forty years. In 1913 a net total of 42,610 000 lbs., valued at $7,022,571, was imported into China, an increase of 14,359,200 lbs., and $1,576,311 in valuation over 1912. For the first six months of 1914 a total of 22,087,597 lbs. was imported into Shanghai, as against 38,321,598 lbs. for the preceding twelve months. Of the seven firms handling indigo at Shanghai, one is American and six are German. Two leading German houses practically monopolise the trade, and, it is alleged, largely control the matter of market prices. In some instances indigo is shipped direct to Tsingtao, Hankow, Newchwang, Foochow, and Canton, but Shanghai is the chief distributing centre. The manufacturers of indigo have expert chemists attached to the distributing offices of their agents in Shanghai, who study conditions and cater for the racial peculiarities of the Chinese in the matter of colours. It is said that the offices are at present well stocked, and that the war will not interfere with this trade for some time to come. This statement is borne out by the Customs returns for Shanghai for the first six months of this year. The Chinese, however, are striving to produce a satisfactory substitute for foreign indigo, and the claim is made that they have to some extent succeeded.

PROPOSED ANGLO-RUSSIAN BUILDING TRADES AND DECORATIVE ARTS EXHIBITION.—Amongst architects and artists in Russia a desire has been expressed to remove German influence on the architectural and decorative arts in that country and to replace it by British. The matter is being taken up the Russo-British Chamber of Commerce, 4, Gorochovaid, Petrograd, and after the war is over it is proposed to hold, with the co-operation of the Chamber, an Anglo-Russian Building Trades and Decorative Arts Exhibition in Petrograd. It is to be hoped that this movement on the part of our Allies will receive every encouragement from those interested in architecture and the decorative arts in this country.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

JANUARY 27.—HON. JOHN COLLIER, R.O.I., "Portrait Painting—the Technique of the Great Masters." LORD SANDERSON, G.C.B., K.C.M.G., will preside.

FEBRUARY 3.—OCTAVIUS CHARLES BEALE, Chairman of the Australian Manufacturers' Association, "Imperial Industrial Development after the War." GEORGE R. PARKIN, C.M.G., LL.D., D.C.L., Organising Secretary of the Rhodes Scholarship Trust, will preside.

FEBRUARY 10.—F. VINCENT BROOKS, "British Lithography in 1915."

FEBRUARY 17.—ARTHUR WILCOCK, "Decorative Textiles, and the Designer's Relation to the Industry."

FEBRUARY 24.—W. J. ASHLEY, M.A., M.Com., Ph.D., Professor of Commerce in the University of Birmingham, "The Economics of the War."

MARCH 3.—WILLIAM POEL, "Shakespeare's Profession."

MARCH 10.—J. W. GORDON, "Patent Law Reform and the War."

MARCH 17.—H. M. THORNTON, "The Industrial Uses of Coal Gas."

MARCH 24.—LADY LUGARD, "The Work of the War Refugees' Committee."

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

FEBRUARY 11.—CAPTAIN SIR GEORGE DUFF DUNBAR, Bt., I.A., "Tribes of the Brahmaputra Valley." LIEUT.-COLONEL SIR FRANCIS YOUNGHUSBAND, K.C.I.E., LL.D., D.Sc., will preside.

MARCH 18.—LIEUT.-COLONEL A. C. YATE, I.A. (retired), "The Indian Army."

APRIL 15.—M. M. S. GUBBAY, I.C.S., "Indian Trade and the War."

MAY 13.—PERCEVAL LANDON, "Basra and the Shatt-ul-Arab."

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

JANUARY 26.—MAJOR E. H. M. LEGGETT, R.E., D.S.O., Managing Director of the British East Africa Corporation, "The Economic Development of British East Africa and Uganda." SIR OWEN PHILIPPS, K.C.M.G., will preside.

FEBRUARY 2.—EDWARD R. DAVSON, "Sugar and the War." LORD DESBOROUGH, K.C.V.O., will preside.

MAY 4.—S. CHAS. PHILLIPS, M.S.C.I., "The Empire's Resources in Paper-making Materials."

Dates to be hereafter announced :—

THOMAS WORTHINGTON, "The Work of the Commercial Intelligence Branch of the Board of Trade."

T. THORNE BAKER, "The Industrial Uses of Radium."

FRANK BAINES, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

E. W. HULME, "Patent Law."

D. Y. CAMERON, A.R.A., R.E., "Etching."

ROGER FRY, "Post Impressionism in Design."

C. H. SHERRILL, "Ancient Stained Glass."

A. S. E. ACKERMANN, B.Sc., Assoc.M.Inst.C.E., "The Utilisation of Solar Energy."

CHARLES R. DARLING, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

INDIAN SECTION.

Thursday afternoon, at 4.30 o'clock :—

May 13.

COLONIAL SECTION.

Tuesday afternoon, at 4.30 o'clock :—

March 30.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

F. MOLLWO PERKIN, Ph.D., F.I.C., F.C.S., M.Inst.P.Tech., "Oils, their Production and Manufacture." Three Lectures.

Syllabus.

LECTURE II. — JANUARY 25. — Low temperature carbonisation—cracking of oils—Motor spirit—Fuel oils.

LECTURE III.—FEBRUARY 1.—Vegetable oils—Raw materials—Sources of supply—Methods of manufacture—Methods of refining—Edible oils—Paint oils.

M. H. BAILLIE SCOTT, "House Building—Past and Present." Three Lectures.

March 15, 22, 29.

DAVID SOMMERVILLE, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

FOTHERGILL LECTURES.

Monday evenings, at 8 o'clock :—

PROFESSOR VIVIAN B. LEWES, F.I.C., F.C.S. "Motor Fuel." Three Lectures.

February 15, 22, March 1.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JANUARY 25...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Dr. F. Mollwo Perkin, "Oils, their Production and Manufacture." (Lecture II.)

Surveyors' Institution, 12, Great George-street, S.W., 8 p.m. Messrs. J. G. Head and J. Bury, "The Report of the Land Inquiry Committee on Urban Land Tenure."

Geographical Society, Burlington-gardens, W., 8.30 p.m. Dr. V. Cornish, "The Historical and Physical Geography of the Theatres of War."

Actuaries, Institute of, Staples Inn Hall, Holborn, W.C., 5 p.m. Mr. C. H. Maltby, "The Analysis of Life Office Expenses."

TUESDAY, JANUARY 26. ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4.30 p.m. (Colonial Section.) Major E. H. M. Leggett, "The Economic Development of British East Africa and Uganda."

Royal Institution, Albemarle-street, W., 3 p.m. Professor C. S. Sherrington, "Muscle in the Service of Nerve." (Lecture II.)

Civil Engineers, Institution of, Great George-street, S.W., 8 p.m. 1. Discussion on paper by Mr. A. L. Bell, "The Lateral Pressure and Resistance of Clay, and the Supporting Power of Clay Foundations." 2. Mr. F. D. Evans, "Engineering Operations for the Prevention of Malaria."

Photographic Society, 35, Russell-square, W.C., 8 p.m. Mr. H. Hardwick, "The Romance of London."

Anthropological Institute, 50, Great Russell-street, W.C., 8.30 p.m. Presidential Address by Dr. A. Keith, "The Slav and Allied Racial Elements in the Peoples of Western Europe."

Electrical Engineers, Institution of (Local Section), 17, Albert-square, Manchester, 7.30 p.m. Mr. T. D. Robertson, "Electric Steel-Making Furnaces."

WEDNESDAY, JANUARY 27...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. The Hon. John Collier, "Portrait Painting—the Technique of the Great Masters."

Literature, Royal Society of, 20, Hanover-square, W., 5 p.m. Miss Alice Law, "The Cult of the Child-Spirit in Modern Literature."

THURSDAY, JANUARY 28...University of London, University College, Gower-street, W.C., 5.30 p.m. Monsieur C. Poupeye, "Belgian Art. Lecture II.—Sculpture."

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. H. G. Plimmer, "Modern Theories and Methods in Medicine." (Lecture II.)

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mr. C. Robbins, "Out West—*viâ* the Canadian Rockies."

Electrical Engineers, Institution of, Victoria-embankment, W.C., 8 p.m. Professor A. Gray, "Lord Kelvin's Work on Gyrostatics."

FRIDAY, JANUARY 29...Chadwick Public Lectures, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 5.15 p.m. Dr. F. M. Sandwith, "War and Disease." (Lecture III.)

Royal Institution, Albemarle-street, W., 9 p.m. Mr. D. Clerk, "Gaseous Explosions."

Junior Art Workers' Guild, 6, Queen-square, W.C., 8 p.m. Mr. C. R. Ashbee, "The Teaching of Art."

Electrical Engineers, Institution of (Local Section), The University, Birmingham, 7.30 p.m. Professor A. Gray, "Lord Kelvin's Work on Gyrostatics."

SATURDAY, JANUARY 30...Royal Institution, Albemarle-street, W., 3 p.m. Dr. R. T. Glazebrook, "Aerial Navigation—Scientific Principles." (Lecture II.)

Journal of the Royal Society of Arts.

No. 3,245. VOL. LXIII.

FRIDAY, JANUARY 29, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 1st, 8 p.m. (Cantor Lecture.) F. MOLLWO PERKIN, Ph.D., F.I.C., F.C.S., M.Inst.P.Tech., "Oils, their Production and Manufacture." (Lecture III.)

TUESDAY, FEBRUARY 2nd, 4.30 p.m. (Colonial Section.) EDWARD R. DAVSON, "Sugar and the War." LORD DESBOROUGH, K.C.V.O., will preside.

WEDNESDAY, FEBRUARY 3rd, 8 p.m. (Ordinary Meeting.) OCTAVIUS CHARLES BEALE, Past President of the Australian Manufacturers Association, "Imperial Industrial Development after the War." GEORGE R. PARKIN, C.M.G., LL.D., D.C.L., Organising Secretary of the Rhodes Scholarship Trust, will preside.

Further particulars of the Society's meetings will be found at the end of this number.

CANTOR LECTURE.

On Monday evening, January 25th, DR. F. MOLLWO PERKIN, F.I.C., F.C.S., delivered the second lecture of his course on "Oils, their Production and Manufacture."

The lectures will be published in the *Journal* during the summer recess.

COLONIAL SECTION.

Tuesday afternoon, January 26th; SIR OWEN PHILIPPS, K.C.M.G., in the chair. A paper on "The Economic Development of British East Africa and Uganda" was read by MAJOR E. H. M. LEGGETT, R.E., D.S.O., Managing Director of the British East Africa Corporation.

The paper and discussion will be published in a subsequent number of the *Journal.*

LIST OF FELLOWS.

The new edition of the List of Fellows of the Society is now ready, and can be obtained by Fellows on application to the Secretary.

COVERS FOR JOURNALS.

For the convenience of Fellows wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6*d*. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

SEVENTH ORDINARY MEETING.

Wednesday, January 27th, 1915; LORD SANDERSON, G.C.B., K.C.M.G., Vice-President of the Society, in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Dean, Oliver H., A.B., LL.B., 116, East 36th-street, Kansas City, Missouri, U.S.A.

Parris, Hamilton Harcourt, The Croft, Grenville, Grenada, British West Indies.

Taylor, H. Blake, 22, Cromwell-crescent, S.W.

The following candidate was balloted for and duly elected a Fellow of the Society:—

Soule, President Andrew McNairn, Sc.D., Ph.D., State College of Agriculture, Athens, Georgia, U.S.A.

The paper read was—

PORTRAIT PAINTING.

THE TECHNIQUE OF THE GREAT MASTERS.

By The HON. JOHN COLLIER.

It is very difficult to learn anything about the technique of the Great Masters of portrait painting. One has plenty of anecdotes about their habits and manners (which were often somewhat unsatisfactory), but hardly anyone condescends to tell us how they painted.

It is possible, however, to pick up a hint here and there, and something may be learned by a mere inspection of their works. At any rate, in the course of my studies I have come across some interesting details, and I have formed certain opinions, which I propose to put forward for what they are worth.

We will not go back to the ancients. No doubt excellent portraits were painted in classical times, but we do not know enough about them to discuss them with any profit.

I will also pass over the Middle Ages, and come at once to the Great Masters of the Renaissance. Of these one of the greatest is Holbein, who in manner is still somewhat mediæval, although in date he belongs to the early Renaissance. His portraiture is apt to be a little stiff and somewhat lacking in charm, but, having made these reservations, we can give it our profound admiration. His drawing and modelling are extraordinarily subtle, and his grasp of character prodigious. He seems to give one more insight into his sitter than almost any other portrait painter even the greatest. As for his method there is, unfortunately, no documentary evidence; we must find it out for ourselves. He made a very careful preliminary drawing on paper, which was transferred by tracing to the canvas or panel, generally the latter. He did not depart from this drawing in any essential, although he often slightly improved on it. Many of these drawings have come down to us—they are of extraordinary delicacy and accuracy. Having made this tracing, he surrounded all the important contours with a very thin dark line of paint. The subsequent work never entirely obliterated this thin line. It can only be seen by minute inspection, but it is to be found in all his pictures. He probably began with a light underpainting in monochrome, as was the practice of the Van Eycks, but of this we cannot be certain. The paint was always thin and smooth, and highly finished. All the details, whether of dress or background, are rendered with the utmost care. Any pattern is given in its completeness; he never adopts the practice of later painters of indicating pattern where the light catches it, and losing it in the shadows. It is always there, although so delicately rendered that it seems lost in places. There is no focussing: the head is not thrown into artificial relief by blurring or suppressing the accessories, and yet everything takes its place. The head is so lifelike that it is never overpowered by the surrounding detail. As you fix your eye on any part of the picture you can see it sharply defined (as you do in Nature), but you are never worried by this, as there is no over-emphasis. You are not forced to look at comparatively unimportant details, but you can do so if you like, and find them true to life.

One consequence of this is that the picture looks right from almost any distance. It can be peered into quite closely or viewed as a whole from some way off. In neither case does it suffer.

I rather dwell on this as it is a characteristic of all early work. It was only the later painters who invented a sort of shorthand so that the picture can only be properly seen at a certain distance. When looked at nearer than this distance it seems merely a mass of blurs and smears. This has a charm of its own, for it looks, and is, so masterly. The effect seems to be produced by such strange and inadequate means. But to me there is great pleasure in being able to look closely into a picture and to enjoy the delicacy and precision of its detail.

The freer and more summary method is to be seen at its best in the later works of Velasquez and of Rembrandt. These have to be looked at from a considerable, but never from an excessive, distance. In the case of large works, such as "Las Meninas," it is about the distance at which one would naturally stand in order to take in the whole picture at a glance. Many modern artists go much further than this. Even works of a moderate size have to be looked at from the end of a large gallery to seem at all coherent, and even then—but I will not pursue this somewhat painful subject.

To return to the earlier masters, it is only when we get to Titian that we find any variety of texture and any play of brush work, and even with him it is not very marked. Titian's portraits are very elaborate, but there is a certain suppression of detail and a greater breadth of effect than is found in any earlier work. Titian's pictures seem to have been built up by a very slow process, and his portraits are probably no exception to this rule.

Here is an account of his method. It has come down to us through Boschini, who knew the younger Palma, whose father had received instruction from Titian himself. The pictures were first laid in very solidly with only four colours, a red earth (possibly venetian red), with white, black, and yellow (the yellow was probably yellow ochre). There was no blue; but black and white make a bluish grey, which would be sufficient to indicate this colour in the first painting.

Boschini speaks of four pencillings which were done in this way, and then the picture was put aside for several months. When he took it up again he first amended and corrected all the forms. He then finished very laboriously with continual glazings, and also with rubbings of opaque colour frequently applied with the finger instead of with the brush. "In this way he gradually gave to his works that bloom and perfection of rich surface and that fulness of colour in which his paintings surpass all others," as Boschini justly observes. The essential point about this method is that it is so indirect. The painting was first executed in very dull colours, and the full effect was only arrived at by a protracted series of glazings and scumblings. In one form or another this indirect method was a very favourite one with the older masters, and indeed with many later ones. Sir Joshua Reynolds followed fairly closely on Titian's method, except that he speeded it up a good deal, and his first paintings were with a still more restricted palette; and up to quite modern times some kind of under-painting approaching to a monochrome has been very generally adopted. But of late this indirect method of painting has been entirely abandoned. I do not know any modern painter who practises it.

It seems rather absurd to criticise adversely a method which, in Titian's hands, has given us some of the finest paintings which the world has ever seen; but I certainly think that for portraiture a more direct technique is preferable, and, indeed, this preliminary underpainting was by no means universal even with the old masters. I do not believe that either Velasquez or Rembrandt made any approach to a monochrome preparation.

We have seen that Titian was the first great painter to make much use of texture and of varying surface in his painting. Before his time the surface was uniformly smooth. It is quite possible to suggest a rough texture on a smooth surface, as we can see any day in photography; even a smooth shiny photograph can perfectly represent a wrinkled skin or a rough-cast wall, and what a photograph can do a picture can do, but it involves a great deal of labour. In skilful hands a certain roughness of paint can represent a rough surface as truly as, and much more expeditiously than, the minute alterations of light and shade which convey the appearance of texture in a photograph or in a smooth painting. That all varieties of surface can be represented by appropriate brush work was most fully realised in the later work of Rembrandt. Since then many artists have essayed it, but none with his mastery. Velasquez had also a great power of brush work, but in this he did not equal Rembrandt, though in many other qualities of portraiture I think he surpassed him. I hold that Velasquez and Rembrandt carried the art of portraiture—at least, male portraiture—to the highest level it has ever attained. They were both so indifferent to female beauty that their portraits of women, however masterly, are quite lacking in that essential charm which is given so wonderfully by the great English school of the eighteenth century.

I have tried hard to discover any authentic testimony as to the methods of Velasquez; but, as usual, we have to rely more on inspection of his works than on any contemporary records.

Señor de Beruete, a distinguished Spanish painter, who made a lifelong study of Velasquez, and has written an admirable book upon him, is the best authority I know on the technical side. According to him, Velasquez painted on a red priming in his early work; this gradually changed to a neutral grey in his later style. The impasto of this priming becomes less and less—towards the end it only just covers the canvas, the grain of which is moderately fine even in big pictures. In the "Bacchus" the priming was reddish There are places, especially round the figures and accessories, where this priming has never been covered; so instead of working his figures into the background each part was painted separately, carefully following the drawing. In his later period he became presbyopic, so not being able to see close he had to get further and further away from his canvas, which made his execution more summary. In his latest pictures he used very fluid colours, in some places only floated on, as in water-colours, and there is no impasto save in the head and hands. So far I have followed Señor de Beruete, but I disagree with this dictum. Velasquez used impasto freely enough in the draperies, even in his latest style. I also disagree as to the brushes used by Velasquez. De Beruete says that he always used round brushes, and that there is nothing in his pictures to indicate that he ever used flat ones. I am quite convinced that there are many broad sweeping passages in the master's work that can only be rendered by broad flat brushes. It is interesting to note that Palomino, who wrote only sixty-four years after the death of Velasquez, states that he painted the portrait of Admiral Pulido y Pareja with

exceptionally long brushes, in order to get more vigour and relief; De Beruete entirely rejects this testimony—I think on insufficient grounds. He also denies the authenticity of the portrait of the admiral in our National Gallery, and ascribes it to Mazo. Here, again, I entirely disagree with him. It is a magnificent portrait, well worthy of Velasquez, and very much above the high-water mark of Mazo. With regard to the long brushes, it is true that they must have been abandoned by the time he painted "Las Meninas," a much later work. This picture is an invaluable document as to the practice of Velasquez. He is standing up to his easel with quite a small round palette in his hand, and the brushes are round and of very moderate dimensions; but then he is probably supposed to be just putting the finishing touches to his picture. It is absurd to imagine that he would paint the broader passages of such an enormous canvas with such little brushes. The colours on the palette are given by De Beruete as vermilion, white, terre de Seville, and carmine; and there are indications of three or four sombre tones, which may be blacks or browns. There seems no trace of the blue and yellow that he must have often used.

The room is a big one, very lofty, and lighted from the side by high narrow windows. As he was painting the little princess and the maids of honour, it has been supposed that this was not his usual studio, but merely a room in the palace used for the occasion. I think myself it was very likely his ordinary painting room; it seems well adapted for the purpose, and there are many pictures on the walls, such as artists accumulate in their studios. In any case, this is the room in which he painted what was perhaps his masterpiece. At the risk of wandering a little from my immediate subject, I may mention that one of the great qualities of this picture is that for the first time in art an effort has been made—and an extraordinarily successful one—to give absolute truth of light and shade; and more than that, to give the effect of atmosphere that pervades all natural scenes. For the first time in art a room has been made to look like a real room, with the figures in it bathed in a real atmosphere and lit up with the light and shade of Nature.

This is a very extraordinary achievement. Some of the Dutch painters, such as De Hoog and Vermeer, have given much the same impression of truth to Nature in the relation of figures to their background; but it is a very rare quality in painting, and no one has done it quite so well as Velasquez. It is occasionally essayed in modern times, but rarely with complete success. The best example that I know is "A Venetian Interior," by Sargent. This is a very wonderful work, but by the side of "Las Meninas" it is a little lacking in simplicity. There is too much virtuosity in the touch, and altogether it is a little too brilliantly dexterous. In looking at it one's first thought is, How amazingly clever! One does not say that in front of "Las Meninas."

To return to the actual method of painting employed by Velasquez. In his early period the execution was precise and very hard. He was fond of dark shadows and clear-cut outlines. In the middle period the paint was put on very solidly and simply, but with much greater freedom; the execution could not be called hard, but was definite and precise. In the third period it was freer still; rather vaguer and softer, and much more subtle. In this later period the paint was put on quite thinly in the shadows, so that the texture of the canvas can be seen through—in places it looks hardly more than a slight modification of the thin grey priming. But however thin the shadows were, they were not painted with transparent colour. It was opaque colour, but very thin and liquid. The lights, especially in the flesh, were solid. The whole seems floated on to the canvas very delicately and subtly, but with an extraordinary economy of labour. At the end certain accents, such as the dark of the eyes or the shadow of the nostrils, were put on with the scratchy touches of a small brush, and the painting was finished—at least, so it looks at the proper distance. Seen near it is just a few soft smears and a dark scratch or two. But then these smears are so wonderfully true in tone and in form. When one has achieved a mastery such as that painting seems surprisingly easy.

Velasquez was not afraid of making alterations when necessary; but one of the characteristics of his work seems the sureness of his intention His pictures are conceived, as a whole, from the very beginning, and yet he made no studies or preliminary sketches—at least, practically none have come down to us. Through all the three periods his colouring remains simple and subdued, but extraordinarily harmonious. It is mostly in the key of grey.

I think this is all that can be said with any safety as to the methods of Velasquez. The case of Rembrandt is still more difficult. He seems to have worked in a studio with a very

small window, so as to get the powerful effects of shadow in which he delighted. His chiaroscuro is far more artificial than that of Velasquez. It is extraordinarily skilful, but to me it is too arbitrary to be quite satisfactory. Again, the warmth of his colouring is unnatural, although very pleasing. He was a great colourist, but somewhat lacking in variety. He affects almost exclusively the browns, reds, and yellows, but within this limited range his mastery is supreme. The extraordinary success of Rembrandt in the key of brown has led many artists to imitate him in their colour-schemes, but mostly with disastrous results. For most painters the greys of Velasquez are much safer, besides having the advantage of being truer to Nature.

The early work of Rembrandt is careful and precise, but it is not hard like that of Velasquez. The execution is smooth, and there is no attempt to render texture by brush work. The best example of this early period is the celebrated "Lesson of Anatomy," at the Hague, painted when he was twenty-six—an extraordinary masterpiece for so young a man

In spite of the size of the picture the execution is so delicate that the hairs at the end of a moustache are drawn separately with a fine brush, and yet the effect is broad and forcible. This force is gained by a powerful effect of light and shade, and by a certain breadth of treatment, but not by any vigour of handling. The hands in this early work are particularly good. In his later style Rembrandt was apt to be careless in this respect.

In his middle period, the beginning of which is marked by the so-called "Night Watch." the most amazing of all his pictures, his execution has become much more masterly. Dr. Bode speaks of a soft buttery impasto as characteristic of the works from about 1645 to 1659, and in contrast describes the painting of the heads in "The Syndics" of 1661 as loose and granular, and with some exceptions I think this can be taken as fairly descriptive of the methods of his middle and latest periods.

It is in this third or latest period that Rembrandt's full mastery over the resources of oil paint is achieved. I am convinced that he then painted on a dark ground; the paint was put on thickly and so manipulated with stiff brushes as to give any variety of texture he required. He would sometimes dig right through the paint to the ground below. In this manipulation of the actual texture of the paint Rembrandt is supreme — no one has ever done it so well before or since.

The portrait of an old man in our National Gallery, painted in 1659, is a fine example of this vigorous and masterly brush work.

There is another Dutch painter, Franz Hals, whose brush work has been extolled almost as much as Rembrandt's. It is certainly supremely dexterous, but it is not so really masterly. Rembrandt, by the texture of his paint, actually renders the wrinkled skin of old age. Hals does not attempt to do this. He merely excites our wonder by showing with how few touches he can produce the illusion of a finished painting. The method of Hals appears at first sight to be extraordinarily simple. He seems to be more a draughtsman than a painter. The shadows are put in with clear, decided touches, and modelling is less thought of apparently than the accurate placing of the accents which mark the features. The hair is painted with great coarse strokes, like an enlarged drawing. Then the colour of the heads is mostly poor, hardly more than one even tone with brown or black shadows. He seems to have kept all his fine colouring, and it was sometimes very fine, for his costumes and accessories. At least, this is how I used to think of Hals' work, but of late I have begun to appreciate it better, and to find all sorts of very delicate subtleties of modelling, and even of colour, where before I had only been struck by a certain coarseness of effect. And I have lately come across a contemporary account of his work which shows that the method was not quite as simple and as straightforward as it seems.

According to Houbraken, Van Dyck said of Hals: "He had never known anyone who had such power over his brush that after laying on the portrait he could render the important touches in the lights and shades and in the right place with one stroke of the brush without blending or changing; the first stage in his portraits had the effect of an indeterminate blur, then followed the broad brush strokes as if the master said, 'Now the painter's handwriting must come in.'"

This sheds a flood of light on the technique of Hals. I certainly never suspected that the first stage of his portraits resulted in an indeterminate blur, but I can understand how valuable this preparation for the final decided touches would be. No doubt it was this that gave the subtlety, whilst the firm touches gave the dash and vigour.

This is how I conceive Hals to have painted. He used a smoothish canvas with a light yellow-brown priming. One can see this priming in

the head of a man at the National Gallery. It forms the ground colour of the hair. He, no doubt, drew in his picture carefully but very broadly. Then came the indeterminate blur which gave the subtle modelling with the merest indication of the features. This was left to dry. Then at the final sitting a very thin coat of the flesh colour was passed over the whole face, broadening and simplifying but not obliterating the modelling given by the blur. Then on the wet paint came the decided touches—"the handwriting"—which gave with the fewest possible strokes the drawing of the features and the matchless vivacity of the expression.

I have dwelt so much on the method of Hals as it is the foundation of what is best in modern portraiture. Mr. Sargent's work is curiously reminiscent of Hals. He has the same admirable vivacity of pose and of expression; the same resolute determination that the finished picture shall have all the freshness of a sketch; the same apparent economy of means, the perfection of the few touches that give all the illusion of elaborate finish when seen at the proper distance.

Of course, in one branch of his art Mr. Sargent has far excelled his master—Hals seldom painted women; when he did they had no charm. Mr. Sargent has painted many beautiful women very beautifully. Nearly all that is most vital in modern portraiture is derived from Mr. Sargent, and through him from Franz Hals.

In some ways I regret that it should be so. It is a fine method, though not, I think, the very finest. At any rate, it is a pity that so many other fine methods should be unrepresented in modern art. For instance, I have been longing for some time for a movement of "back to Holbein." I can imagine no more wholesome corrective of the modern tendency to sloppiness and haste, but I regret to say that I can see no sign of it.

Rembrandt is too elusive to be followed with any profit, but the methods of Velasquez are so simple that I think they might be imitated with some hope of success.

Then there is another Dutch painter who produced masterpieces by sheer force of competent industry. There was no secret about the method of Van der Helst. It just consisted in painting everything as well as he possibly could in an absolutely straightforward manner. Surely some of us could do the same, if we would but take the trouble? We should have to take a great deal, for there are no short cuts in the laborious method of Van der Helst; but no one can look at his great picture of the Banquet of the Civic Guard without feeling that a method which produced this masterpiece is not to be despised.

So far, portraiture has been very uncompromising. Painters have never flattered their sitters. They have endeavoured to render them just as they are. The great Velasquez never flattered, although as a Court official there must have been some temptation to do so. But when we come to Rubens and Van Dyck we see a distinct endeavour to be polite to their aristocratic sitters. Velasquez never succumbed to the atmosphere of the Court, but they did, Van Dyck perhaps more than Rubens, being the weaker man. From their time onwards portraiture has never been quite free from the vice of over-politeness except in quite modern days, when we run very distinctly to the other extreme. I sometimes wonder why people go on having their portraits painted, as most modern artists are so singularly unkind to their sitters.

Both Rubens and Van Dyck were men of extraordinary gifts, but they were both courtiers and both over-prolific, and their art suffered accordingly. The essential point of the technique of Rubens is his insistence on the transparency of the shadows. He is reported to have said: "Begin by painting your shadows thinly; be careful not to let white insinuate itself into them—it is the poison of a picture except in the lights; if white be once allowed to dull the perfect transparency and golden warmth of your shadows, your colouring will no longer be glowing, but heavy and grey. The case is different in regard to the lights; in them the colours may be loaded as much as is thought requisite. It is necessary, however, to keep them pure. This is effected by laying each tint in its place, and the various tints next each other, so that by a slight blending with the brush they may be softened by passing one into the other without stirring them much. Afterwards you may return to this preparation and give to it those decided touches which are always the distinctive marks of Great Masters."

From this it is obvious that there was no monochrome preparation. The painting from the first was fully coloured. Rubens used a white ground which shone through his transparent shadows and gave them a wonderful warmth and luminosity—often too much. His touch is very liquid, so that he obviously used a very fluid medium. The portraits are altogether a little artificial, but they are very dexterous, and have a most agreeable swagger. He had,

as I have said, a tendency to flattery, in pursuit of which he often made the eyes too big—a very fatal fault. Holbein, on the other hand, had a slight tendency to make the eyes too small.

Van Dyck's work at his best is sounder than that of his master. He made less use of transparent shadows, thereby getting much more truth of tone. He was quite as fine a colourist, and, on the whole, a better draughtsman. His technique is to be seen at its best in the portrait of an old man in our National Gallery who is now called Cornelius Van der Geest. He was justly proud of this portrait, and used to take it about with him as a specimen of his work. The brush work is very dexterous, much more so than in most of his portraits.

Both Rubens and Van Dyck adopted the pernicious practice of making use of pupils and assistants.

Here is a contemporary account of Van Dyck's usual routine :—

" He never worked longer than one hour at a time on each portrait. When his clock told the hour he rose and made a bow to the sitter, as much as to say that enough was done for that day; after which his servant came to prepare fresh brushes and palette, while he received another person to whom he had given an appointment.

" After having lightly sketched the face, he put the sitter in an attitude that he had previously meditated, and with grey paper and black and white crayons he drew, in a quarter of an hour, the figure and drapery, which he arranged in a grand manner and with exquisite taste. He then handed over the drawing to skilful persons whom he had about him to paint it from the sitter's own clothes, which were sent on purpose at Van Dyck's request. The assistants having done their best with the draperies from Nature, he went lightly over them, and soon produced by his genius the art and truth which we there admire. As for the hands, he had in his employment persons of both sexes who served as models."

I need hardly point out the vices of this system. The marvel is that the work should be as good as it is, but in the last years of his life in England, to which the above description applies, he painted a number of very indifferent portraits. His earlier work during his stay at Genoa, when he probably painted his pictures himself, without much aid from assistants, is very much finer.

The next really important group of portrait painters is to be found in the great British School of the eighteenth century, when Reynolds, Gainsborough, and Romney were all painting at the same time. In their conception of portraiture this group was much influenced by Van Dyck. They had the same tendency towards a sort of courtly elegance, and they were much inclined to flatter their sitters. As painters of men I should judge them distinctly inferior to Van Dyck, but as painters of women much superior. Van Dyck, with all his elegance, never quite got the charm of womanhood—indeed, many of his female portraits are stiff and almost wooden.

But our three great painters had an extraordinary feeling for the grace and beauty of women and children. Never have they been more charmingly portrayed.

With regard to technique, Sir Joshua certainly aimed at reproducing the Venetian manner and colouring, and at his best he was very successful in so doing; but he was always making rash experiments, and was continually varying his practice, with often disastrous results to the permanence of his pictures.

Here is a description of his early practice by an amateur painter who was admitted to his studio :—

" On his light-coloured canvas he had already laid a ground of white, where he meant to place the head, and which was still wet. He had nothing on his palette but flake-white, lake, and black, and without making any previous sketch or outline he began with much celerity to scumble these pigments together till he had produced, in less than an hour, a likeness sufficiently intelligible yet withal cold and pallid to the last degree; at the second sitting he added, I believe, to the other colours a little Naples yellow."

He must have used a fuller palette for the subsequent sittings, but that is not mentioned. It *is* mentioned that this particular picture " very soon faded, and soon after the forehead cracked, almost to peeling off, which it would have done long since had not a pupil repaired it."

This was in 1754. There is a letter of Sir Joshua's in 1770 describing his practice then, when he was forty-seven years old.

" I am established in my method of painting. The first and second paintings are with oil of copaiba (for a medium), the colours being only black, ultramarine, and white. The second painting is the same. The last painting is with yellow ochre, lake, black, and ultramarine, and without white, retouched with a little white and the other colours." In spite of his saying that

he was established in his method of painting, he was continually altering it, but he kept to the main lines—a very cold and bluish preparation, corrected afterwards by warm glazes. As for medium, besides the oil of copaiba, he often used megilp (a mixture of oil and mastic varnish), and a varnish made by dissolving wax in Venice turpentine. He was very fond of this wax varnish, and frequently went over his pictures with it after they were finished.

I may add that he adopted Van Dyck's pernicious system of having a sort of picture manufactory. He had a big house in Leicester Square, with numerous rooms for his pupils, copyists, and drapery men. His pupils served also as models for hands and draperies. With the aid of his assistants he turned out his pictures at a surprising rate. In one year he produced 150 works — about half of what Gainsborough produced in the whole of his life. But Gainsborough had no manufactory - no assistants; his pictures were entirely the work of his own hands. Gainsborough's method was strikingly original. Here is an account by an eye-witness: "I was much surprised to see him sometimes paint portraits with pencils on sticks full six feet in length, and his method of using them was this: He placed himself and his canvas at a right-angle with the sitter, so that he stood still and touched the features of his picture exactly at the same distance at which he viewed his sitter."

Velasquez is said to have tried this method of ong brushes, but did not persevere with it. Gainsborough probably did. I think it is habitual in his later work. It gives a delightful sketchiness of execution, which sometimes degenerates into mere scratchiness. He made many preliminary sketches for his pictures, sometimes mere scribbles, but at other times fairly elaborate studies. For full-length portraits he would first make a small sketch of the figure in oils before beginning to work on the full-sized canvas. From this sketch he would lay in the complete figure with all its accessories, and then finish from the sitter.

As a portrait painter Gainsborough had many defects. He was not a good draughtsman; his figures are often very faulty in proportion, the hands are habitually badly drawn, and he had a peculiar way of representing eyes — he made them very expressive, but their form was distinctly not that of Nature; also there is rather a fatal family likeness in a good many of his female portraits. And the men's portraits are often flimsy and weak. But no painter has had a greater measure of that very elusive quality, charm. His portraits of women are the most charming in the world.

He was a very fine and original colourist, and a master of decorative arrangement. Altogether a most delightful painter, but with limitations.

There is a very interesting appreciation of Gainsborough's work by Reynolds in one of his discourses. He says: "It is certain that all those odd scratches and marks which on close examination are so observable in Gainsborough's pictures, and which even to experienced painters appear rather the effect of accident than design, this chaos, this uncouth and shapeless appearance, by a kind of magic at a certain distance assumes form, and all the parts seem to drop into their proper places, so that we can hardly refuse acknowledging the full effect of diligence under the appearance of chance and hasty negligence. . . . His handling, the manner of leaving the colours—in other words, the methods he used for producing the effect—had very much the appearance of the work of an artist who had never learnt from others the usual and regular practice belonging to his art."

Sir Joshua evidently felt that Gainsborough ought not to have been a good painter, but he had to acknowledge that he was one; indeed, he goes on to say: "It must be allowed that this hatching manner of Gainsborough's did very much contribute to the lightness of effect which is so eminent a beauty in his pictures."

As for Romney, I have been unable to find any contemporary record of his technique.

We will now consider Raeburn, who marks the transition from the eighteenth to the nineteenth century, and whose work has had a surprising vogue of late years. I think myself that Raeburn is a somewhat overrated painter; but he has had undoubtedly a great influence upon modern work. His method is essentially that of Franz Hals. It is extraordinarily direct and very masterly; but the characterisation is not nearly as good as that of Hals, and he mostly misses the extraordinary vivacity of expression that distinguishes the Dutch master.

As in the case of the great painters of the eighteenth century, there is a strong family likeness in his portraits. There are one or two of very different gentlemen which seem almost identical. He was essentially a mannerist, although the manner was very strong and good. Fortunately we know something about his practice. Here are some notes collected by Sir

Walter Armstrong in his monograph on Raeburn:—

1. He seldom kept a sitter more than an hour and a half or two hours.

2. He never gave more than four or five sittings to a head or bust portrait.

3. He did not draw in his subject first with chalk or charcoal, but directly with the brush on the blank canvas.

4. Forehead, chin, and mouth were his first touches.

5. He placed the easel behind the sitter and went away to look at the picture and sitter together.

6. A fold of drapery often caused him more trouble than the build and expression of a head.

7. He never used a maulstick.

From these notes we gather that Raeburn's method was singularly direct. He certainly made no kind of preparation. He aimed at putting every touch on the canvas as right in tone and drawing as he could get it. If he were successful in this it remained unmodified. If it were unsuccessful it had to be redone. I do not think he repainted the whole head each time, as was Whistler's practice. If a touch was wrong it was repainted firmly and solidly; if it was right he left it alone. So that the finished picture is a sort of mosaic of definite touches, each of them apparently put on the canvas with one sweep of the brush. In his earlier works he carried this method so far that his faces look much too hard—as if they were cut out with a hatchet. Oddly enough, Raeburn's work did not become more summary as he grew older, as is the case with most artists. On the contrary, his modelling became much more subtle, and his touch softer and more fused—to the great improvement of his painting.

And now we come to the moderns. I have always considered Millais one of the greatest of modern painters, and I can speak with some confidence of his technique, as I had the privilege of his friendship, and he used to allow me to see him paint.

In life-sized portraits he always put his canvas side by side with the sitter, and walked backwards and forwards the whole length of his studio, putting on a touch, and then looking at it from a distance to see if it was right. If it was not right he would come forward again to modify it; this modification he often did with his finger.

He once said to me, "Get away from your picture till it looks the size of a postage stamp, and then you will see if it is right or not."

He did not draw his picture very elaborately, but he was careful how he put it on the canvas. Having made a rapid sketch of the general attitude, he got to work at once on the head with the full vigour of a rich palette, just rubbing in lightly a little of the background round it. At the end of the first sitting the head looked very much as it did at the end of the final one; he only added accuracy and refinement to it. He was not very particular as to his execution; he wanted his painting to look like Nature, and he did not much care how he did it. As he said once, "It doesn't matter how beautifully a thing is painted, it's no good if it isn't right; it's got to come out. What does it matter how you do it? Paint with the shovel if you can't get your effect any other way."

Millais rather despised mere technique, that is, any very definite method of painting—possibly he despised it too much. Mr. Comyns Carr in his recent book, "Coasting Bohemia," relates how, "One day we were talking of technique, and I remember Millais, who was at the time in some trouble with a portrait that he could not get to his satisfaction, roundly declared that for an artist worth the name there was no such thing as technique. 'Look at me, now,' he said, 'I can't get this face right, and it has been the same with me all through my life: with every fresh subject I have to learn my art all over again.'" It was perhaps this absence of a definite technique which made Millais' work so very unequal, but it helped to give him his marvellous freshness and variety. Each portrait is absolutely individual, and has no trace of that fatal family likeness that we find in mannerists such as Raeburn.

A very different painter was Whistler—a man of great natural ability, but who was too much bound down to his method. He took immense pains, but his great preoccupation was to make people think that he did not take any. No matter how many sittings he had—and he generally had a great many—he always wanted his picture to appear as if it had been entirely painted at one sitting. So each time he went over his whole picture and repainted it afresh. As it is impossible adequately to paint a whole portrait at one sitting, he merely spoilt his work, and neglected the more valuable elements of portraiture in order to attain the quite secondary advantage of an agreeable sketchiness.

In other respects his method was sound enough, and had the merit of extreme simplicity. I have been given some very interesting notes

as to Whistler's technique by a well-known artist who worked for some years in his studio.

"He put the picture side by side with the sitter. The canvas had a grey preparation made with black and white mixed with turpentine. He did not use a palette, but had a table near him, on which he mixed the tones he was going to use. This was a very important part of his practice; before actually painting his picture he mixed with great care a quantity of the tones he would require, such as background colour, floor colour, coat-colour in the light, ditto in the half-tone, ditto in the shadow; flesh colour in the light, in the half-tone, and in the shadow; hair colour in the same way, etc. He had a mixture of oil and turpentine in a saucer standing on the table. Using this as a medium, he covered thinly the whole canvas with these prepared tones, using house-painters' brushes for the surfaces, and drawing lines with round hog's-hair brushes nearly a yard long. His object was to cover the whole canvas at one painting—either the first or the hundredth. When a thing was incomplete, he did not try to patch it; he did it all over again and again, till it was finished, or wrecked, as often happened, from the sitter getting tired or growing up or growing old.

"He would put the mixtures in little gallipots of water round the table, so that he could depend upon taking up the same tone another day.

"For many of his portraits he used a quite black background. He had a square of black velvet nailed on to an easel which he wheeled about. The lighting was always subdued; his sitter posed far away in the penumbra of the studio, and never under a direct light. He said he hated high lights in a picture."

What was best in Whistler's practice was his intense preoccupation with the tones; and be it observed that these very delicate tones, that in his best work are so beautifully harmonious, are put on in the simplest possible way—just ordinary paints carefully mixed, and then put on thinly with a big brush. I think this is a sufficient refutation of the theory that "quality" in painting can only be obtained by broken colour, or by glazing, or scumbling, or other tricks. Whistler's work has a very fine quality, and it is obtained by the simplest possible means. If only he had not spoilt it all by his mania for repainting the whole picture each time, he might have obtained results not so very unworthy of Velasquez, whose method was also completely simple, but far more rational.

And now we come to the greatest of modern portrait painters, John Sargent. Sargent is like the old painters, in that he has a very definite method of which he is completely master. There is very little that is tentative about his work. He knows what he wants to do, and also how to do it—a quality which is very rare in modern art where most of us are fumbling and bungling with no clear aim and no settled method.

As I have said, Mr. Sargent's work is undoubtedly founded on that of Franz Hals. It has the same quality of sureness of touch combined with great delicacy. In this, indeed, he excels his master; there is much more delicacy in Sargent's flesh tones and more refinement of drawing. Also he has a feeling for beauty in which Hals was almost lacking. But there is a vigour and a directness in the older master and a vivacity of expression that even Sargent does not always equal. I feel some diffidence in giving an account of Sargent's technique, as it does not come direct from himself. He wrote to me about it very kindly some years ago, and this is what he said: "As for describing my procedure, I find the greatest difficulty in making it clear to pupils even with the palette and brushes in hand and with the model before me, and to serve it up in the abstract seems to me hopeless. It is less a technical process than an order in which to proceed."

That is, he carries out the painting in a certain definite order. Of course this order is very important, and I do not despair of elucidating it. Mr. Sargent has taught with great success in the Academy schools, and I have been given some notes of his procedure by one of his pupils, which I think are quite trustworthy. This was the procedure:—

"First, a careful drawing of the masses of hair, face, collar, coat, etc., together with the correct placing of the subject on the canvas, with spots giving the exact location of the features. Secondly, using a large brush with plenty of paint, put in the tone and colour of the background as nearly correct as possible, letting the background well overlap the borders of the portrait. Thirdly, a kind of middle tone of the flesh is painted over the whole flesh space—light on the light side, dark on the dark side—painting the tone right into the background (background into flesh, flesh into background, until the effect of the truthful blending or melting of the one into the other is obtained); so with the hair and flesh and hair and background. When this is finished the head ha

something the appearance of a wig-maker's block. Of course, the drawing round the borders of the masses must be very thorough, not only in the pattern of its mass but in the coming and going of the edge—as true to Nature as it is possible to get it. The broadly graduated tone from the light side to the dark must be truthfully expressed. There are as yet no features. With the canvas arranged by the side of the sitter, and going to the full length of the studio, this preliminary painting is carefully tested from the point of view of drawing, colour, and tone.

"It is then carefully noted where the broad tones of the features should be placed in relation to all that has been done. The broad tone, in which may be said to dwell the eye, is then painted into the big middle tone while wet and fresh, being careful to have it right in colour, tone, and drawing, that on the light side differing from that on the dark side exactly as it is in Nature. It will then have the effect of a receding plane.

"As with the eyes, so with the nose—a kind of middle tint between the light and dark side to indicate its form and place; so with the nostrils, again with the mouth and chin, continually viewing the progress of the work from the far end of the studio.

"Then follow the various relationships in tone of the darks, subtly cast shadows and the like, vigorously brushed into the wet paint, and then the lights in their various relationships, until the whole appears to be true in tone.

"This would all be the first day's work. It is left to dry, and on resuming is oiled out carefully and well brushed with a dry brush to remove all superfluous oil.

"The whole picture is then thoroughly criticised, and the same ground gone over in much the same way, using as far as possible the work of the first painting by working thinly over it, never forgetting that the tones must be brushed fearlessly and well, the one into the other (sometimes the light into the dark, sometimes the dark into the light), so that the two fuse together and are felt as a continuation of the same substance."

To these notes I have an important addition by another student, viz., that at the end of the day everything should be brushed together whilst the paint is wet in order to get rid of all sharp edges. So that we are getting somewhat near to the indeterminate blur of Franz Hals—to be followed, of course, by the decided touches which, as Van Dyck said, give, as it were, the handwriting.

The method of Sargent is so predominant in modern art that most of our clever young painters seem to adopt it in some form or other—at least, those of them who have not degenerated into pure freakishness, of which there are, alas! far too many. It certainly has wonderful results in the hands of its originator, but it is a difficult method, and it has this danger — that the cleverness of the painting seems often to attract more attention than the rendering of the personality of the sitter. Indeed, the followers of Mr. Sargent are so desperately anxious to be clever that they often forget to be good. With many of them the method degenerates into mere pretentious sloppiness. Mr. Sargent is a genius, and a genius must go his own way, but those of us who have no genius (and there are still a few left) had better avoid the difficulties with which he plays so easily and so deftly.

DISCUSSION.

The Chairman (Lord Sanderson) said it was usually convenient that the Chairman should initiate the discussion which habitually followed the reading of papers at the Society's meetings, but he desired at once to say that he accepted the office of Chairman on the present occasion for the purpose of listening as an acolyte, and that he was quite incompetent to speak with any authority on the subject. He could only join with the rest of the audience in thanking the author for a most interesting paper, which had, for a time, taken their thoughts away from more exciting but rather painful subjects, and for exhibiting a very beautiful series of illustrations. There was, he believed, a book entitled, "How to Look at Pictures." He imagined that most people looked at them anyhow. He was in ordinary times inclined to frequent the National Gallery, when their energetic lady friends allowed it to be open for inspection; and, quite irrespective of the pleasure of looking at the pictures, he found a good deal of amusement in listening to the observations of other visitors. He had wondered sometimes what the appreciations were of the troops of small school children who came in with a rush, cast themselves down on their stomachs on the floor before some great masterpiece, and began scribbling in note-books. He once heard a man addressing a friend as they stood in front of a certain Baptism in the River Jordan which had been the subject of heated controversy, say, "Don't tell me that Raphael or Perugino ever painted a shoulder like that." He felt inclined to ask very humbly, "What, never?" for even Raphael and Perugino must have had a beginning. On another occasion, in the same room, two carpenters looked

for a moment at the Ansidei Madonna, and one of them said, "That canopy is out of the square"—which he believed it was. But he did not think he ever realised how much additional interest arose from some knowledge of the manner in which pictures were painted until he once had the privilege of walking through the gallery with a Royal Academician and hearing his remarks on the pictures, their various characteristics, and the methods by which the effects were obtained; and he felt sure that the majority of those present, though they might be less ignorant than he (the Chairman), would find that what they had heard that evening would add largely to their pleasure, besides improving their power of criticism. There was one question which had often exercised his mind. Why was it that when looking at certain pictures, for instance, Raphael's portrait of Pope Julius II., or Velasquez's portrait of Admiral Pulido, they felt at once convinced that they were accurate likenesses of the originals, and could they be quite sure that the impression was a correct one? They were not always right in such matters. There were certain aged people, who, they felt convinced, must have been exceedingly handsome when they were young, but he had in some instances been assured that good looks had come with years. He fancied that all they could really be confident of in regard to such matters was that the artist formed to himself a complete and consistent idea of the character as well as the appearance of his sitter, and carried it through in all respects. One remembered the remark of the artist who made the portrait of Francis Bacon, "I had rather paint his soul if I had a canvas worthy of it." And that, perhaps, might supply an explanation of the undoubted want of charm in the female portraits of some of the Dutch masters to which the author had alluded. It was possible that they either could not, or did not, take the trouble to realise the grace of their characters, or possibly they might have allowed their female sitters to get bored, and boredom had a dreadful effect upon the female countenance. A friend of his, who sat for a presentation portrait, remarked to the artist, when he was at last allowed to look at it, "I quite see that this is a very good work of art, but I don't think anyone can say it is the portrait of a handsome man"; upon which, he ruefully declared, the artist at once said that any attempt at alteration would probably spoil the likeness. He (the Chairman) would never have contended that his friend was an Adonis, but a good many of those who knew him thought that neither the likeness nor the picture would have suffered if he had been rather more favourably depicted. He was taking up too much time with what was, after all, mere gossip, and he would only ask one small question of detail, and conclude with an anecdote—trivial, but, he believed, historical. He had been told that after Holbein had once made the pen-and-ink drawings of which they had heard he troubled his sitter no more, and did his colouring from memory without comparing it with the original. That, if true, would account for some peculiarities of his portraits, and it would also have made him a very popular painter with busy men. The anecdote he wished to tell was as follows: It was said that King Edward VII. as a boy was fond of drawing, and rather a proficient. On one occasion, finding a nice piece of paper in the library at Windsor Castle, he devoted himself to producing a work of art. It was being handed about and criticised, when someone looked on the other side of the paper, and found it occupied by a pen-and-ink drawing of the Court Painter of Henry VIII.

Sir Thomas Holdich, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc. (Chairman of the Council), in proposing a cordial vote of thanks to the author for his most interesting paper, said that if there was one point in it with which he ventured to disagree it was that artists should go back from the days of Sargent to those of Holbein, because, speaking for the man in the street, he had infinitely more respect and affection for the works of modern artists, as exhibited yearly in the Royal Academy, than for the stiff and unsympathetic system of portraiture which existed in the days of Henry VIII. Nevertheless, he was in full sympathy with the Chairman's remarks as to the educational value of being able to see what were the points of a picture from the artist's point of view. As a very humble dabbler in landscape painting, he could attest the statement that one soon learnt to notice all sorts of things in Nature that one never observed before from the simple process of trying to imitate Nature's scenes. Delicate little indications of light, shade, colour and form, which would have passed absolutely unnoticed in earlier days, caught the eye and appealed to the imagination almost at once after a certain amount of experience in the attempt to delineate Nature as it was seen. It was exactly the same in visiting the Art galleries. He felt it would be an immense advantage to him if he could see, as the painter saw, a little behind the mask of the man and discerned something of the soul that was in him, and if he could really feel with the painter that he was representing a man and not merely an image.

Mr. Carmichael Thomas, in seconding the motion, said a very large number of people knew the author as an excellent and conscientious portrait painter, and a larger number still knew him as a painter of problem pictures. Nobody gave more cause for dissension at the family table than Mr. Collier did in the month of May. The audience also knew him as an excellent lecturer, the paper being full of instruction and humour.

The resolution of thanks having been put and carried unanimously,

The Hon. John Collier, having thanked the audience for the very kind way in which they had received his paper, said the Chairman had asked whether Holbein actually painted his portraits from his sitters. It was quite true that, on the preliminary drawings Holbein made, there were, generally, little notes as to colour and various things of that kind; he carefully prepared his pictures from those drawings and notes, and laid them in broadly with the colours that were required and with a careful outline, but he had not the smallest doubt in the world that, having done that, he had recourse to the actual sitter and finished his picture from the sitter himself. It was impossible for such fine works to have been otherwise produced. He did not suggest for a moment that artists should abandon the method of Sargent entirely for the method of Holbein. He thought Sargent's method was an admirable one in Sargent's hands. If anybody was able enough to follow it, it was a very good one, but it was so difficult a method that a good many of its followers failed to achieve success. He would like to see painters try all the various methods that had produced such fine portraits in the past. They should follow Holbein a little and Titian a little, if possible—the latter was very difficult—and certainly Velasquez if they could. They should try different methods and not keep entirely to one kind of portraiture.

REFRACTORY MATERIALS AND THE WAR.

By Alfred B. Searle, Ph.D.

The successful manner in which the Germans have developed the manufacture of various heat-resisting materials has been clearly demonstrated since the advent of the war, and as time goes on the absence of supplies becomes more and more trying in those industries where heat-resisting materials are required. The manufacture of chemical porcelain, for instance, is almost unknown in Great Britain,* and we have to depend for supplies of this ware on goods which are obtained more or less surreptitiously through neutral countries such as Holland and Scandinavia. The supplies stocked by dealers have never been very large, and these were rapidly depleted. This encouraged a number of British potters to make some simple attempts at the manufacture of refractory porcelain, but most of them soon abandoned it, for though they could make ware which would withstand acid they could not produce a porcelain with the insensitiveness to sudden changes in temperature which is so characteristic of the Saxon ware. Other experiments are being continued, and it is hoped that before long this ware, which is so important to chemists, will be successfully manufactured in this country at prices not markedly higher than have been paid for the imported material. Meanwhile, the use of fused silica ware or "vitreosil" is increasing, as it will meet all the requirements but is more costly than porcelain.

The importation of bricks for building coke ovens and other furnaces from Belgium and other parts of the Continent has necessarily ceased during the war. Firebricks of equal refractoriness can be purchased in this country, but they do not satisfy the tests which the Continental builders of coke ovens consider to be essential. British firebrick manufacturers are making extensive efforts to overcome these objections, and are gradually increasing their ability to make firebricks to fit any reasonable specification. They have much to learn, however, though they have made much more rapid progress since the war began. Firebricks for furnaces and similar purposes where the specifications are less stringent can be made successfully in this country, though the prices of firebricks in extra-European countries before the war were largely in favour of those made in Germany. This was due to the much larger works, organised on an entirely different basis and working on a system of "dumping" which does not appeal to British manufacturers. It is a curious fact that with inferior materials to those commonly used in Great Britain, the Germans have turned out better firebricks and have been able to guarantee results to an extent which British firms have found impracticable. With competition less severe in some respects, British manufacturers are now turning their attention to improving the qualities of their goods, as in the past they have concentrated their minds on the production of cheap bricks. With adequate technical assistance of a kind not generally available they will be able to make great improvements in quality, and should, in time, be able to produce better bricks than any now on the market.

Retorts for the manufacture of coal gas cannot now be imported from Germany, so that gas engineers are compelled to use the home-made products. There is much divergence of opinion as to the relative values of British and German retorts, and it has not been unusual to find German engineers importing British retorts, whilst some British engineers have preferred to purchase German ones. Here again British manufacturers are trying to meet the demands as far as they are able to do so.

The chief difference between British and German refractory materials may be traced to the difference in the ownership and management of the firms. In this country refractory materials are chiefly made by men who have worked themselves up from a small beginning—or the descendants of such men—their chief characteristic being that of a workman whose knowledge and experience have been gained almost entirely in the workshop, and whose theoretical knowledge—either of chemistry, physics, or mechanics—is almost negligible. The German manufacturers of refractory materials, on the contrary, have almost invariably had a sound training in chemistry and engineering; they approach the manufacture from an entirely

* But see the General Note on "Laboratory Ware" on p. 207.—Ed.

different point of view—namely, that of the user turned manufacturer. Consequently they are more impressed with the needs of the user, whilst the British manufacturer is chiefly impressed with the difficulties of manufacture and the limitations imposed by his material. If once this bias could be overcome—and the only remedy is the better education of the manufacturers—there is no question that better refractory goods can be made in Great Britain than can be obtained from the Continent for the same price.

LARGE CONTRACTS FOR ROLLING STOCK IN ITALY.

Some large contracts for rolling stock, probably the largest ever given out at one time, have lately been placed by the Administration of the Italian State Railways in the hands of seventeen different firms, to be made in that country.

The total value of these contracts, including the construction of 5,545 vehicles, of which 5,366 are for ordinary and 179 for reduced gauge, will amount to 56,302,000 lire (£2,252,080 sterling).

The vehicles will consist of 1,385 passenger carriages, 500 luggage vans, and 4,481 trucks and vans for different purposes.

The prices to be paid are as follows:—

		Lire.	£
1st Class Carriages . .	each	54,100	(2,164)
1st and 2nd Class (mixed) .	,,	52,950	(2,118)
2nd Class	,,	52,150	(2,086)
3rd Class	,,	41,450	(1,658)
Luggage Vans	,,	26,700	(1,068)

The prices for vans and trucks vary according to type, viz.: 6,725 lire (£269); 5,125 lire (£205); 10,600 lire (£424); 15,900 lire (£636); 7,080 lire (£283·4).

The narrow-gauge material is chiefly for lines of local interest in Sicily.

GYPSUM DEPOSITS OF THE STATE OF OKLAHOMA.

By Chas. N. Gould, Ph.D.

Gypsum, or sulphate of lime, is widely distributed throughout the western part of the State of Oklahoma. It occurs in rocks of Permian or Upper Carboniferous age, which in this region are known as the Red Beds.

The Red Beds, as exposed in western Oklahoma and the adjacent States of Kansas and Texas, consist of a great mass, several thousand feet thick, of red clay shales. Interstratified with these shales are certain well-defined ledges composed of gypsum.

As found in Oklahoma, gypsum occurs in five separate forms, namely—as rock gypsum; as earth gypsum, or gypsite; as selinite; as satin spar; and as concretionary gypsum. Only the rock gypsum and gypsite have so far been utilised commercially.

By far the most abundant exposures of the material in Oklahoma are in the form of rock gypsum, which material occurs in a number of counties in the western part of the State. This rock gypsum is found in definite ledges, varying in thickness up to 100 ft. The rock is white and massive, and, being harder than adjacent strata, weathers out in the form of conspicuous lines of hills or buttes. The famous "Gypsum Hills" of Oklahoma and Kansas, which are composed of several ledges of rock gypsum, extend north and south for a distance of nearly two hundred miles, and stand out 150 to 200 ft. high above the level plain to the east. This formation is known to the geologist as the Blaine gypsum.

Farther south and west a second line of gypsum hills, not so conspicuous as those just mentioned, extends from west-central Oklahoma to central Texas. This formation, which is known as the Greer gypsum, is made up of five or more separate beds of white massive gypsum, separated by red clays and shales.

Gypsite, or earth gypsum, is usually found in the vicinity of rock gypsum. It is a finely powdered, ashy material, light grey to brown in colour. It is composed of disintegrated rock gypsum, mixed with a certain amount of earthy material.

Gypsum is utilised largely in the manufacture of wall plaster, stucco, plaster of Paris, Keene cement, and other similar products. At various times some fifteen different mills for the manufacture of these products have been erected in the State of Oklahoma. The product manufactured at these mills finds a ready market throughout the southern and western States.

It has been estimated that the amount of rock gypsum available in Oklahoma approximates 123,000,000,000 tons.

THE DEVELOPMENT OF THE CHOCO INTENDENCY.

The Intendency of the Choco is situated in the north-western part of Colombia, between 3° 58′ and 8° 45′ north latitude and 76° 14′ and 77° 51′ west longitude. Its greatest length from north to south, from Punta La Miel to the Calima River, is 350 miles; its greatest width from east to west is 83 miles. The area of the Choco is 18,610 square miles. It comprises the Provinces of Atrato and San Juan. According to the census of March 5th, 1912, the population was 60,544, as compared with 50,185 in 1906. Supreme authority in the Choco is invested in the Intendent, who is appointed by the President of Colombia for two years. The Intendency has no assembly, and the police and other departmental laws are enacted by the assembly of the Department of Cauca (to be distinguished from the Department of Cauca Valley, or El Valle), in which the Choco has no representative. Each of the provinces is governed by a prefect, who is the immediate agent of the Intendent. Quibdo, the capital of the Intendency and of the Province of Atrato, had a population of 15,756 in 1912. It is situated on the eastern bank of the Atrato River, at the point where this stream receives the waters

of the Quito and Cobi Rivers, 270 miles from its outlet into the Gulf of Uraba or Darien.

Only a small percentage of the land is under cultivation, though the soil is of the best alluvial variety and extremely fertile, producing every kind of crop grown in the tropics. Every native family has its small homestead, where enough is grown to supply the family. Agricultural methods are of the simplest variety. Ploughs, harrows, and other modern implements are unknown, such work as these are ordinarily used for being accomplished, if at all, by large knives called "machetes." After the tropical growth is cleared with the machete, corn is scattered broadcast on the surface, or the plantain slips are merely thrust into the ground. The American consular agent at Quibdo says that a large amount of territory is available, and foreigners with perseverance and capital might make a success of agriculture on a large scale. The plantain is probably the article most extensively grown in the Choco, and constitutes with fish and rice the staple food of the country. Estimates place the number of plantain trees in the Choco at 15,000,000. The climate and soil on the lower Atrato are especially suited to rice cultivation, but only about 1,000 acres are planted in rice, most of the supply being imported from the East *vià* Germany.

The number of cacao trees (*Theobroma cacao*) is about 600,000, of which over 400,000 are around Pizarro, 40 miles south-west of Quibdo. The trees are usually 18 to 20 ft. in height with a trunk 8 or 9 ins. in diameter, covered with a cinnamon-coloured bark. The leaves are large and oval. The flowers are reddish, odourless, and usually clustered in groups attached directly to the trunk or the long branches of the tree, where the reddish or brownish oval fruit, 4 or 5 ins. in length, also grows. When the shell of the fruit is opened, 30 to 50 seeds arranged in five vertical rows are found nestled in a bed of pulp. The seeds, about the size and shape of an almond, when dried in the sun turn brown and are ready for market. They are bought at from *5d.* to *10d.* per lb., ground and mixed with sugar and cinnamon. A low-grade chocolate is thus produced, which is consumed in the country. The coco palm, of which there are about 100,000 in the Choco, grows along the coasts, especially around the Gulf of Darien. Vanilla and ipecacuanha trees grow wild in the forests near the mouth of the Atrato. Large quantities of the ipecacuanha root are exported to the United States. A small patch of sugar-cane is cultivated by every family, which also makes its own brown sugar.

The valleys and hills of the Choco are covered with forests, a large part of which consists of trees suitable for lumbering, though many are still unknown commercially. The cedars and "huino," which are very similar, grow in abundance throughout the country. The "canalate," "tuave" and "bosai" are valuable woods, all of a canary-yellow hue, the canalate especially being very hard. The "chonta," a variety of palm about 20 ft. high and 6 or 7 ins. in diameter, is widely used as an exterior surface for houses or made into window-bars. The foundations and framework of buildings are generally built of lignum vitæ. "Mora," from which black dyes are made, and mahogany are both found near the coast. Cedar, huino, mahogany and mora logs are exported to the United States. The Choco is one of the most important districts for the tagua nut or vegetable ivory industry. The tagua palm, 10 or 12 ft. high, grows wild in the forest. Each tree has 6 to 10 clusters containing pods, which break open when ripe, dropping to the ground the nuts and the surrounding pulp. The period required for the clusters to form and ripen is two years, the harvest continuing during the whole year.

The ivory nut district is near the mouth of the Atrato. A virgin forest of tagua has been recently discovered about the head-waters of the Salaqui River, a tributary of the Atrato, in which it is roughly estimated that there are 200,000 trees, which will produce 10,000 to 20,000 tons of ivory nuts. The tagua forests are Government property and are not for sale. The tagua nut when dried has the appearance and texture of dental ivory, and because of the facility with which it can be sawn, carved, dyed and polished, has come to be extensively used as a substitute for the rare and expensive ivory, in the manufacture of buttons, door-knobs, toys and other articles. Probably 8,000 tons of these nuts are exported from the River Leon, which flows into the Gulf of Darien; about 3,000 tons from the River Sucio; 600 tons from the Baudo River district, and 700 tons from Acandi, on the Gulf of Darien. At Cartagena the nuts are re-shipped, mostly to Germany. Although rubber cultivation has only been recently begun, it is estimated that there are 1,500,000 trees in the Choco, by far the largest number of which have been planted. After the metals, rubber is the principal export of the Choco, when prices are favourable. Many species of orchids grow throughout the Choco, and collections reported to be extremely valuable have been sent abroad. There are said to be numerous medicinal plants, from which the natives prepare various ointments.

The gold-mining district of the Choco extends from the junction of the Negua and Atrato Rivers south to the mouth of the San Juan. Almost all the deposits are alluvial. Most of the gold and platinum exported is obtained by native women, working two or three hours a day. They use the antiquated ground-sluicing process as a preliminary to get rid of the coarser gravels, and then with their "bateas" separate the metals from the sand and gravel. The "batea" is a wooden pan, shaped like a very shallow inverted cone, 18 ins. in diameter, and 3 ins. deep at the centre, with two small handles or knobs on the rim. The women handle the bateas with great dexterity, throwing off the gravel and sand by a rotary motion and leaving the gold and platinum dust in the common centre. Another method of mining that is extensively employed by these women is dipping into 3 or 4 ft. of water for the sand and gravel

containing the metals and bringing it up in the bateas. This method is usually more remunerative than the sluicing process.

The gold workings have existed for centuries, but little has been done in the development of the district. The river gravels were being washed by the Indians long before the advent of the Spaniards, and this region furnished much of the gold that was carried back to Spain. In those days the value of platinum was unknown, and when the Indians brought the metal down to the Spanish headquarters in Quibdo the platinum was thrown away. Large finds of this discarded metal have been made recently in Quibdo, and frequently the earth excavated for foundations has yielded sufficient quantities of platinum to pay for putting up the building. The natives were beginning to pan even the streets, thus uncovering large amounts of mud, which was injurious to health. A decree was therefore promulgated in 1913 prohibiting any further washing of earth in the streets of Quibdo. By a law that came into effect in 1910, foreigners are not allowed to denounce or purchase mines in the Choco, but mining property can be leased for a long period. It is expected that within a few years mining on a large scale will be begun. Even under the primitive conditions of the present day the Choco stands second only to Russia as a producer of platinum, and the prospects under improved methods are considered favourable.

THE DEVELOPMENT OF THE TEXTILE INDUSTRIES.

Dyers and Dyestuffs.—The differences of opinion disclosed in the reception given to the Government dyestuffs project leave one common ground for regret. From every point of view it is a pity that the scheme submitted was not one to command the adhesion of those who were asked to carry it into effect. The initial scheme being dead, observations upon it are useful only as far as they apply to alternative schemes, and happily its death does not mean that nothing further is to be done to liberate English consumers from dependence upon German suppliers of tar colours. It is well in the first place to realise who are the parties to the direct consumption of dyestuffs. The direct users belong, broadly, to one of two classes—those to whom the cost of dyestuffs is important, and those to whom it is not. Such textile manufacturers as dye their own goods are, in the main, in a large way of business. Colour for dyeing is one of their minor expenses, and the cost of dyeing represents some 1 or 2 per cent. of the total value of the goods. Economy is important in all industrial purchases, but a small addition to the expense of dyeing has a manifestly limited effect upon the total cost of the goods. However, the consumption of colour is not principally in their hands. The great bulk is used by the commission or public dyers, who have just three major expenses, wages, coal, and colour; and to a commission dyer in comparatively a small way a saving of 5 per cent. in dyestuffs translates itself into some hundreds sterling per annum. Rightly or wrongly, the commission dyers have formed the opinions that the present war with Germany will be the last in their time, and that after the war German colours will be not dearer but cheaper than ever. They hold also that for an appreciable period it will cost more to manufacture certain important dyestuffs in England than in Germany. The opinions are given as the prevalent ones, without disrespect to the alternative notion that for a limited time German colours will be dearer after the war, and without regard of their soundness.

Dyers' Competitors.—The commission dyer, in short, insists that he must and will have the cheapest suitable dyestuffs which can be procured —be they German or other. His business is one existing separately from the spinning and weaving of the goods sent to him for treatment, and one capable of being transferred abroad. Not a few Lancashire cottons are sent abroad undyed to be dealt with by Oriental and other craftsmen. The cotton dyer is exposed also to factory competition—for example, from Dutch dyers and calico printers. Not solely for reasons of price, British silks have for years past been sent in small quantity to be dyed black in Lyons and Crefeld. If no large quantity of woven worsteds have been sent abroad in the grey state, it is still true that the advantage of importing undyed rather than dyed cloth has been fully considered in America. Many countries admit undyed at a lower tariff than dyed cloth, in the ostensible interests of the local dyeing industry. While in the cases named the separate interests of the dyer are alone affected, it is sufficiently apparent that the ability to offer shades of a particular degree of fastness is a matter affecting the disposal of orders for weaving as well as for dyeing. Indubitably, in some circumstances, to put obstacles in the way of the English dyer is to promote the export of undyed, unfinished, and unwoven goods at the expense of business in the completed article.

Cheap Colours.—The interest of the textile public in the matter of dyewares is that of the consumer, and not that of the colour manufacturer. It follows that any solution of the difficulty involving a general rise in prices must encounter commercial as well as political opposition. British consumers might be said hitherto to have been spoiled, for they have obtained German colours at prices only rendered possible by the significant provision in the general terms of sale forbidding the re-export of the dyestuff from the United Kingdom. Although it has been argued with plausibility that the best security for low prices in the future lay in the investment of capital in colour-making at home, consumers have not shown readiness to act upon so long a view.

Indeed, numbers of consumers have no capital to spare—a proportion of them are, in effect, financed by their colour suppliers and coal merchants. It may be some satisfaction to feel that the breakdown of the Government scheme is due to no fears of the ultimate possibility of establishing a strong British colour industry, and that the rock on which it has foundered is the old one of commercial consideration. The rock is not an easy one to avoid, and it is possible that the navigators paid too little heed to it. While they talked of the larger and more distant prospects, those to whom they spoke thought consistently of the immediate. Had there been nothing more required than the change over from the choice of suppliers to dependence upon a central dyestuff manufacturing organisation, it is certain that some effort would be necessary to make that change agreeable.

Conditions in Germany.—It has been somewhat indefinitely reported for some time that little or no work was being done in the German colour factories. The information is confirmed by a petition, apparently framed in November by the Verein der Deutschen Textilveredlungs-Industrie. The Government was asked especially to facilitate the import of dyewoods and tanning materials, and to restrict the export of chemical colours to neutral countries "so long as German requirements have not been fully covered." It would be instructive to know how much of this inability to cope with domestic needs arises from the cessation of supplies of raw products from England. The other portions of this petition are suggestive, notably the request for "credit facilities in the important branches of the weaving industry," and for aid in importing materials and exporting goods similar to that given to other industries. The Government was asked not to adopt any further measures injurious to the Kartels, and pressed to take steps to moderate the price of living, "because such increase is the principal cause of the contraction of the demand for woven goods." With external trade at a minimum, internal trade in a bad state, prices high for cotton and wool, and an insufficiency of dyewares, the German textile industries can by no means be in a prosperous condition. Approximately, one half of German production lost its markets when the seas were closed against German commerce. As the other half is restricted at both ends it may not be long before work is limited to one or two days a week, and the indefinite continuance of so disastrous a state can be contemplated with no satisfaction in any German circles.

Simplicity and Inventions.—When electricity was newer as a motive force it was regarded with distrust as a power altogether more intangible and incalculable than the steam to which manufacturers were well accustomed. Familiarity has largely removed these fears, without, however, leading to the extensive use of current except for light and power. In a paper before the British Association of Managers of Textile Works, Mr. Frank Nasmith, of Manchester, detailed a number of directions in which electricity has at least some promise of wider use. Pneumatic and electrical forces were considered together, and, of the two, compressed air is the less familiar in general mill practice. The conditions do not obtain in the mill which have made pneumatic transmission widespread in mines and shipyards. The textile manufacturer, except in rare cases, is not a trained engineer, and has not a professional engineer's outlook upon mechanical problems at large. It is to be believed that some managers and employers have not yet overcome prejudices against compressed air resembling those which at an earlier date militated against the use of electricity. Doubtless some objections to air trunks, pipes, and projections are traceable to the overcrowded state of rooms, and others are known in practice to have arisen from an unwieldiness of apparatus incommensurate with the benefits conferred by its use. Doubtless in minimising inconveniences and simplifying his apparatus the engineer is taking the shortest cut to the favour of the manufacturer. Properly enough, the manufacturer is exhorted to keep abreast of science. If he spoke his mind frankly, the manufacturer would probably beg the scientific engineer to reduce his inventions to the lowest and simplest terms. Mr. Nasmith, in dealing with the possible extensions of the use of the newer forces, expressly assumed that any improvements adopted would reduce the manual operations required. The condition is the precedent to their adoption, and it may be urged strongly upon inventors that simplicity is the thing that manufacturers are really seeking.

NOTES ON BOOKS.

Optic Projection. By Professor Simon Henry Gage and Henry Phelps Gage. Ithaca, New York: The Comstock Publishing Company. 1914.

In January, 1911,* Mr. S. H. Gage, Emeritus Professor of Histology and Embryology at Cornell University, contributed to the *Journal* of the Society an interesting article on the origin of the photographic lantern-slide, in which he was able to show conclusively that the earliest application of photography to the projection lantern was made in America. In 1850 transparent positives for use in the lantern were made and advertised by the Brothers Langenheim, who were, according to Professor Gage, the owners of Fox Talbot's American patents. The albumen dry-plate process was the one employed, the use of collodion for photographic purposes not having been discovered

* *Journal*, Vol. LIX. p. 255. See also p. 292 for some further comments on the subject by the Secretary of the Society.

until 1851, when, as is well known, Archer first published an account of his invention.

This article was the outcome of the researches which were being made by Professor Gage, with a view to the publication of the book which has now appeared, "Optic (or, as we on this side of the Atlantic would call it, 'Optical') Projection."

The authors, however, state that although it was their intention when the work was undertaken to include an extended account of the discoveries and inventions relating to vision, this idea was abandoned because the present work had already exceeded its limit in size. The historical matter is therefore reserved for a future work. That it may not be very long before Messrs. Gage undertake the production of such a book is certainly to be hoped, because it would probably be of a greater general interest to students of the subject than the present volume, complete as this appears to be in its own line.

The volume under review is an elaborate and apparently exhaustive account of apparatus used for projection, with all the various artificial lights and also with sunlight, together with all supplementary and kindred apparatus. For instance, the projection microscope is fully described, and there is an elaborate chapter devoted to the cinematograph. The different sources of illumination are fully dealt with; the electric current at considerable length. There is also a chapter on the preparation, use, and preservation of lantern-slides; another chapter on drawing and photography with projection apparatus, and yet another on the projection of images of opaque objects.

The optical principles involved are treated at sufficient length, and indeed there seems little information that an operator can require which he would not find in this book. It is very elaborately illustrated, and is full of detailed instructions for the use of all the appliances described. It should be added that although history has been relegated to a future volume, there is a brief historical summary, and a fairly full bibliography.

GENERAL NOTES.

EGGS IN SHANTUNG.—Shantung is one of the leading egg-producing provinces of China. Chickens are for the most part hatched by a native process of incubation, consisting in placing eggs in earthenware jars, which are set upon kongs or beds built of brick and clay, and within which slow fires, generally of coke or charcoal, are kept burning. The eggs are carefully turned from time to time. The kongs used are generally those which serve the family for beds, each family throughout the country districts rearing a number of chickens in this way. There are no large concerns engaged in this business in the sense that obtains in the poultry industry in this country. Old women, it is said, sometimes carry a number of eggs strapped about their waists, under their outer garments, for incubating purposes. About two weeks after the chickens are hatched they are taken to the market and sold, the family keeping a sufficient number for domestic purposes. The production of chickens and eggs in Shantung is not a business in which anyone engages to the exclusion of other work. The millions of eggs which are produced daily in the province are the collections of a dozen or less from each of the numerous households contributing to the general supply.

VINTAGE IN FRANCE, 1914.—The *Journal Officiel* gives the following statistics respecting last year's vintage in France, which, notwithstanding the war and the occupation of five departments by the Germans, appears to have been most abundant. Those departments from which no returns were available are the Aisne, Ardenne, Meurthe, Moselle, and the Oise.

	1913.		
	Hectolitres.		Gallons.
Stocks	3,791,599	..	83,421,778
Production . .	41,053,832	..	903,184,304
	44,845,431	..	986,606,082
	1914.		
	Hectolitres.		Gallons.
Stocks	5,719,546	..	125,830,012
Production . .	51,134,159	..	1,124,951,498
	56,853,705	..	1,250,781,510

This shows an increase of 10,080,327 hectolitres (221,767,194 gallons) in favour of last year's vintage.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—Lord Fisher, of Kilverstone, and Vice-Admiral Sir Edmond J. W. Slade have been elected honorary members of the Institution of Petroleum Technologists.

INOCULATION AGAINST TYPHOID.—Sir Frederick Treves, speaking at a meeting held in the Society's Great Room on Friday, January 22nd, under the auspices of the Chadwick Trust, said that the proof of the value of the protection afforded by inoculation, as demonstrated by the results in the present Expeditionary Force, was unquestionable. Since the war began there had been in the British Expeditionary Forces—and these figures were astonishing—only 212 cases of typhoid fever, and of these 201 were not protected men. Of these 201, 173 had not been inoculated at all; 28 had received one inoculation, or had not been inoculated for a period of over two years. Of the 212 men there were only 11 men who had been inoculated. These figures could not be gainsaid. Moreover, among these 212 men there had been 22 deaths, and all these deaths had been non-inoculated men, and not a single man had died of typhoid fever in the British Expeditionary Force

who had been inoculated. There the matter ended, and those who attempted to persuade the soldier not to be inoculated played into the hands of the enemy, and gave him exactly the advice the Germans would be only too pleased to give him. Since the delivery of his address Sir F. Treves has obtained later official figures, which he published in a letter in the *Times* of January 26th. They are as follows: Of the first 421 cases of typhoid fever in the present campaign among British troops, 305 were of men who were not inoculated. In the 421 cases there had been 35 deaths. Of these deaths 34 were men who had not been inoculated within two years. Only one death occurred among patients who were inoculated, and that man had only been inoculated once. Sir Frederick pertinently adds: "In view of this evidence, and in view of the grievous injury inflicted upon our gallant troops by those who—in widely disseminated leaflets—advise the soldier against inoculation, one wonders if the Defence of the Realm Act is not sufficiently powerful to put a stop to this heartless crusade and this direct playing into the hands of the enemy."

LABORATORY WARE.—Messrs. A. Gallenkamp & Co., Ltd., announce that a manufacturer in Staffordshire has succeeded in making some porcelain which compares favourably with the porcelain ware for laboratory purposes (such as evaporating basins, crucibles, beakers, etc.) which, up to the beginning of the war, was only obtainable from Germany. The new ware has been tested at the County Pottery Laboratory, Stoke-on-Trent, and pronounced to be as satisfactory as the German. It can also be supplied at prices not much higher than those of the German ware before the war. An association, to be known as the British Laboratory Ware Association, is about to be formed, whose object will be to stimulate the production in this country of a large number of laboratory requisites hitherto only produced in Germany. It was felt that combination of this sort was necessary in order to make it worth while for manufacturers to go to the expense of putting down additional or new plant. It is also stated that the problem of manufacturing a suitable quality of glass beakers and flasks has been solved, and certain sizes are now being made for trial orders.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock (except where otherwise announced):—

FEBRUARY 3.—OCTAVIUS CHARLES BEALE, Past President of the Australian Manufacturers' Association, "Imperial Industrial Development after the War." GEORGE R. PARKIN, C.M.G., LL.D., D.C.L., Organising Secretary of the Rhodes Scholarship Trust, will preside.

FEBRUARY 10.—F. VINCENT BROOKS, "British Lithography in 1915."

FEBRUARY 17.—ARTHUR WILCOCK, "Decorative Textiles, and the Designer's Relation to the Industry." SIR CHARLES WALDSTEIN, Litt.D., Ph.D., will preside.

FEBRUARY 24.—W. J. ASHLEY, M.A., M.Com., Ph.D., Professor of Commerce in the University of Birmingham, "The Economics of the War." The RIGHT HON. SIR GEORGE HOUSTON REID, G.C.M.G., D.C.L., K.C., High Commissioner for the Commonwealth of Australia, will preside.

MARCH 3, at 4.30 p.m.—WILLIAM POEL, "Shakespeare's Profession."

MARCH 10.—J. W. GORDON, "Patent Law Reform and the War."

MARCH 17.—H. M. THORNTON, "The Industrial Uses of Coal Gas."

MARCH 24, at 4.30 p.m. LADY LUGARD, "The Work of the War Refugees' Committee."

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

FEBRUARY 11.—CAPTAIN SIR GEORGE DUFF DUNBAR, Bt., I.A., "Tribes of the Brahmaputra Valley." LIEUT.-COLONEL SIR FRANCIS YOUNGHUSBAND, K.C.I.E., LL.D., D.Sc., will preside.

MARCH 18.—LIEUT.-COLONEL A. C. YATE, I.A. (retired), "The Indian Army."

APRIL 15.—M. M. S. GUBBAY, I.C.S., "Indian Trade and the War."

MAY 13.—PERCEVAL LANDON, "Basra and the Shatt-ul-Arab."

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

FEBRUARY 2.—EDWARD R. DAVSON, "Sugar and the War." LORD DESBOROUGH, K.C.V.O., will preside.

MAY 4.—S. CHAS. PHILLIPS, M.S.C.I., "The Empire's Resources in Paper-making Materials."

Dates to be hereafter announced:—

THOMAS WORTHINGTON, "The Work of the Commercial Intelligence Branch of the Board of Trade."

T. THORNE BAKER, "The Industrial Uses of Radium."

FRANK BAINES, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

E. W. HULME, "Patent Law."

D. Y. CAMERON, A.R.A., R.E., "Etching."

ROGER FRY, "Post Impressionism in Design."

C. H. SHERRILL, "Ancient Stained Glass."

A. S. E. ACKERMANN, B.Sc., Assoc.M.Inst.C.E., "The Utilisation of Solar Energy."

CHARLES R. DARLING, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

AUGUSTUS VERNON HARCOURT, D.C.L., LL.D., D.Sc., F.R.S., "On an Economical and Smokeless Grate, and on the Measurement of the Efficiency of Open Grates."

INDIAN SECTION.

Thursday afternoon, at 4.30 o'clock:—

May 13.

COLONIAL SECTION.

Tuesday afternoon, at 4.30 o'clock:—

March 30.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

F. MOLLWO PERKIN, Ph.D., F.I.C., F.C.S., M.Inst.P.Tech., "Oils, their Production and Manufacture." Three Lectures.

Syllabus.

LECTURE III. FEBRUARY 1. Vegetable oils Raw materials Sources of supply Methods of manufacture—Methods of refining—Edible oils—Paint oils.

M. H. BAILLIE SCOTT, "House Building—Past and Present." Three Lectures.

March 15, 22, 29.

DAVID SOMMERVILLE, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

FOTHERGILL LECTURES.

Monday evenings, at 8 o'clock:—

PROFESSOR VIVIAN B. LEWES, F.I.C., F.C.S., "Motor Fuel." Three Lectures.

February 15, 22, March 1.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEBRUARY 1...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Dr. F. Mollwo Perkin, "Oils, their Production and Manufacture." (Lecture III.)

Victoria Institute, Central Hall, Westminster, S.W., 4.30 p.m. Professor E. W. MacBride, "The Present Position of the Theory of Organic Evolution."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, Society of, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 7.30 p.m. Presidential Address by Mr. N. Scorgie.

Chemical Industry, Society of (London Section), at the Chemical Society, Burlington House, W., 8 p.m. Exhibition of specimens of Chemicals and Apparatus hitherto produced abroad and now being manufactured in this country.

TUESDAY, FEBRUARY 2...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4.30 p.m. (Colonial Section.) Mr. E. R. Davson, "Sugar and the War."

Royal Institution, Albemarle-street, W., 3 p.m. Professor C. S. Sherrington, "Muscle in the Service of Nerve." (Lecture III.)

Alpine Club, 23, Savile-row, W., 8.30 p.m. Mr. H. Raeburn, "In the Caucasus 1914."

Photographic Society, 35, Russell-square, W.C., 8 p.m. Mr. B. C. Wickison, "Effect, its Value in Pictorial Photography."

Rontgen Society, Middlesex Hospital, W., 8.15 p.m. Dr. S. Russ, "Measurements of the Radiations from the Coolidge and other X Ray Tubes in Clinical Practice."

WEDNESDAY, FEBRUARY 3...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. O. C. Beale, "Imperial Industrial Development after the War."

Civil Engineers of Ireland, Institution of, 35, Dawson-street, Dublin, 8 p.m.

Public Analysts, Society of, at the Chemical Society, Burlington House, W., 8 p.m. 1. Annual Meeting 2. Mr. G. D. Elsdon, "Note on the Determination of Sulphates in Flour." 3. Dr. W. R. Schoeller, "General principles governing the complete analysis of Minerals and Ores."

Entomological Society, 11, Chandos-street, W., 8 p.m.

Royal Archæological Institute, at the Society of Antiquaries, Burlington House, W., 4.30 p.m. Mr. A. Vallance, "Reims Cathedral."

Sanitary Engineers, Institute of, Caxton Hall, Westminster, S.W., 8 p.m. Mr. A. H. Mackinney, "Problems of Modern Illumination."

THURSDAY, FEBRUARY 4...Royal Society, Burlington House, W., 4.30 p.m.

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Linnean Society, Burlington House, W., 5 p.m. 1. Dr. Marie Stopes, "A new, well petrified fossil Wood or Bark—Angiosperm or Gymnosperm?" 2. Dr. H. Drinkwater, "Brachydactyly as an example of Mendelian Inheritance."

Chemical Society, Burlington House, W., 8.30 p.m. 1. Mr. S. U. Pickering, "Metallo compounds of cobalt and nickel." 2. Mr. J. N. Rakshit, "Preparation of dinitro-dichloro methane by simultaneous nitration and chlorination of acetone." 3. Mr. M. O. Forster, "Azotisation by chloroamine."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. H. G. Plimmer, "Modern Theories and Methods in Medicine." (Lecture III.)

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mr. S. Greenslade, "Eighteenth Century English Table Glass."

University of London, University College, Gower-street, W.C., 5.30 p.m. Monsieur C. Pompeye, "Belgian Art." (Lecture III.)

Concrete Institute, 296, Vauxhall Bridge-road, S.W., 7.30 p.m. Discussion on report on "A Standard Specification for Reinforced Concrete."

FRIDAY, FEBRUARY 5...Royal Institution, Albemarle-street, W., 9 p.m. Professor A. W. Crossley, "Science and Industrial Problems."

Geologists' Association, University College, W.C., 8 p.m.

SATURDAY, FEBRUARY 6...Royal Institution, Albemarle-street, W., 3 p.m. Dr. H. W. Davies, "Music To Untrained Listeners." (Lecture I.)

Journal of the Royal Society of Arts.

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FRIDAY, FEBRUARY 5, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, FEBRUARY 10th, 8 p.m. (Ordinary Meeting.) F. VINCENT BROOKS, "British Lithography in 1915." CARMICHAEL THOMAS, Chairman of the *Graphic* and *Daily Graphic*, will preside.

THURSDAY, FEBRUARY 11th, 4.30 p.m. (Indian Section.) CAPTAIN SIR GEORGE DUFF DUNBAR, Bt., I.A., "Tribes of the Brahmaputra Valley." LIEUT.-COLONEL SIR FRANCIS YOUNGHUSBAND, K.C.I.E., LL.D., D.Sc., will preside.

Further particulars of the Society's meetings will be found at the end of this number.

CANTOR LECTURE.

On Monday evening, February 1st, DR. F. MOLLWO PERKIN, F.I.C., F.C.S., delivered the third and final lecture of his course on "Oils, their Production and Manufacture."

On the motion of the Chairman, PROFESSOR VIVIAN B. LEWES, a cordial vote of thanks was passed to Dr. Perkin for his interesting course.

The lectures will be published in the *Journal* during the summer recess.

COLONIAL SECTION.

Tuesday afternoon, February 2nd; LORD DESBOROUGH, K.C.V.O., and subsequently COLONEL SIR THOMAS H. HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Chairman of the Council, in the chair. A paper on "Sugar and the War" was read by MR. EDWARD R. DAVSON.

The paper and discussion will be published in a subsequent number of the *Journal.*

COVERS FOR JOURNALS.

For the convenience of Fellows wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1*s.* 6*d.* each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

A meeting of the Colonial Section was held on Tuesday, January 26th, 1915; SIR OWEN PHILIPPS, K.C.M.G., in the chair.

THE SECRETARY of the Section said Lord Kitchener had informed the Society that he would have been very pleased indeed to attend the meeting had the times been normal, and that he took special interest in the two countries under discussion in the paper, but he was sure that the Council would appreciate his inability to find the time to be present.

THE CHAIRMAN said he felt very much honoured at being invited to preside that afternoon. He was quite sure that Major Leggett required no introduction; he was an old member of the Society and had spoken at the Society's meetings on more than one occasion. The territories of British East Africa and Uganda would always awaken deep interest among British people from their geographical setting, their romantic history, the extraordinary rapidity of their growth and progress, and their vast possibilities for future development. No one was better able than Major Leggett to speak on those things. Many names would always be coupled with East Africa and Uganda, and not the least the names of Lord Kitchener and Sir Frederick Lugard; and in future when men looked back on the commercial developments of those countries he thought Major Leggett's name would be remembered with honour.

The paper read was—

THE ECONOMIC DEVELOPMENT OF BRITISH EAST AFRICA AND UGANDA.

By MAJOR E. H. M. LEGGETT, R.E., D.S.O.,
Managing Director of the British East Africa Corporation.

When the Council of this Society did me the honour of asking me to read a paper upon East Africa, I asked leave to couple the two Protectorates, British East Africa and Uganda, and by thus mentioning them separately at the

outset to make it plain that, in the inventory and the Blue books of the British Empire, there appear two names, two countries, and two sets of problems. From that starting point I hope to show you these two great areas are complementary one to the other, each supplying something that the other lacks, so that the course of their development, in part due to organised effort and in part almost automatic, tends more and more to dependence upon a centralised programme. And, lastly, I would hope to indicate something of what I believe to be the inevitable influence of these areas, as governing the economic future of something like one-third of tropical Africa, this power following from the fact that the port of Mombasa is the gateway of the shortest road to the great African system of inland waterways--Lake Victoria, Lake Chioga, Lake Albert, and the head-waters of the Nile.

It may surprise you to hear that the economic history of these countries, in the sense which we are discussing to-day, began barely a dozen years ago. Yet that is literally the fact, and indeed overstates it. It is certainly true that when Great Britain rather reluctantly assumed the pride of adding these areas to the list of countries that it was protecting—and paying for—there was no clear idea how they were to recompense her for her anxieties of governance and expenditure.

It is probably fair to say that England went in with three objects: one business object, viz., to keep someone else out from the head-waters of the Nile; and two objects moral, to destroy the slave trade and to protect the missionaries. The business object, that of occupying a remote and difficult country at great expense to keep Germany out, would be economically sound as an item in the Imperial balance-sheet, but was not expected to be revenue-earning in itself. The other two objects are among those for which the reward is not expected to be of the material order.

A brief historical summary is essential to an understanding how development received its first impulse, and how certain factors came on the scene almost accidentally, but which will probably have a permanent influence on the politico-economic future of East Africa and Uganda. The glimmer of the future came to Sir Samuel Baker, the first European to reach Uganda and Lake Albert. On his return in 1867, from nearly two years spent in what is now the Northern Province of Uganda, he wrote of the fertility of the soil, and the industry of the natives, and he sketched, almost as a dream, the advantages to England if it were only possible, as he doubted how it ever could be, to bring those areas and peoples into communication with the civilised world, to transport their cotton and grain raised by their free labour to the workshops and markets of Europe, and to send them in return the products of the home countries. Baker's trip had been made under the nominal protection and ægis of the Khedive of Egypt, Tewfik Pasha, whose character was so remarkable a combination of the gambler and the statesman. Baker returned to Equatorial Africa in 1869 as the Khedive's Governor-General, and in the same year an Egyptian expedition of troops and warships arrived at Kismayu on the East Africa coast, but only to find a British squadron from the East India station had arrived a few days previously, and the Egyptians returned home. A glance at the map shows the breadth of Tewfik's conception. But this incursion into the territories of the Arab Sultan of Zanzibar was upsetting to the mind of that potentate. His territory ran from Muscat on the Persian Gulf as far south as Cape Delgado, and in his island headquarters he grew rich from the spoils of trading expeditions which penetrated far into the interior of the mainland, bringing back slaves and ivory. The coast-line was one continuous cocoanut plantation, worked by slave labour. It would certainly not suit His Highness to have his chief customer in the slave traffic, the Khedive of Egypt, establishing himself, in the same line of business, in the middle of his own territory. So Sultan Bargash of Zanzibar offered in 1877 to his friend, Sir William Mackinnon, a seventy years' lease of the Zanzibar dominions on the mainland; but our Foreign Office foresaw trouble, and the matter was not then proceeded with. The time was that of the Dual Control in Egypt, when relations between France and England were going through a period of strain that could not have been displeasing to Prince Bismarck. The events of 1882 in Cairo were quickly followed by great activity on the part of Germany in acquiring concessions along the east coast of Africa, and in 1886 England realised the situation sufficiently to step in and peg out a claim in the shape of Mombasa and its hinterland. The boundaries of the Sultan of Zanzibar's dominions were investigated by none other than Captain (now Lord) Kitchener. His next visit to that region was in 1911, on a private holiday trip, and the greeting given him then by old Arab friends of

twenty-five years before was eloquent of the memories his first visit had left behind him.

To resume. This definition of areas led the Foreign Office at last to recognise Sir William Mackinnon's lease, and to confirm it as a Royal Charter granted to Mackinnon's Company, "The Imperial B.E.A. Co.," in 1888. It illustrates the various methods of Empire-building that meantime Germany had secured her 400-mile strip of coast and its hinterland, since called German East Africa, by some pressure and a payment of £120,000 to the Sultan of Zanzibar, displacing all the officials of the latter, and establishing a rigid rule, while England preferred to lease its sphere, maintaining the flag of the Sultan and his officers to administer all Arab questions, and imported Indian officials, whose tradition is to lead rather than to order, and to leave native laws and customs as far as possible undisturbed.

So far the coast. But Emin Pasha, a German subject in Egyptian employ, had by some influence succeeded as Egyptian Governor of Equatorial Africa some years before. He became lost, and in 1889 a German official, Karl Peters, set out to find him. He started from Lamu on the coast, where many German concessions had been secured from Arab chiefs, and the semi-independent Sultan of Witu, and the search party soon displayed itself as a fully equipped expedition, and proceeded to run a ring round the small British sphere of influence. It penetrated to the Lake region, and made territorial treaties with everyone who could claim to be a chief. To the everlasting credit of Great Britain and himself, Mr. (now Sir F.) Jackson, the present Governor of Uganda, who was exploring the interior of East Africa with an Imperial B.E.A. Co.'s party—but actually with, I believe, orders not to go as far as Uganda—heard of Peter's activities, and raced him, keeping the intruder at arm's-length but pushing him gradually away by the polo manœuvre of "riding him off," and thus enabled our Government to deny the German claim of the latter's effective occupation of the territory at the sources of the Nile. Egypt was quiet, and its future beginning to take shape, the French were busy in Algiers and the Sahara, and the British Government began to realise the escape it had had. Captain (now Sir Frederick) Lugard was sent to Uganda to establish the authority of the Imperial Company, for even yet the Imperial Government was reluctant to assume expense and direct responsibility. How Sir Frederick and Captain Williams held on and paid the troops themselves, after being ordered to withdraw, is another instance of taking the chances of success for the flag versus censure of the individual. In 1894 the British Government bought out the Imperial Company, and it is no coincidence that in 1895 Lord Kitchener's patient advance began for the recovery of the Sudan. By 1898 the Uganda Railway was commenced, to reach from Mombasa to Lake Victoria, and in that year Lord Kitchener fought the battle of Omdurman. Thus was the scheme of Tewfik realised, but not by Tewfik. Had he succeeded, who can doubt but that the Mahdi of the Sudan, the bloodthirsty King of Uganda, and the slave-raiding Arabs of the East African coast, would have merely been replaced by an authority as overbearing, as wasteful and eventually as weak, the prey to intrigue, and carrying the germs of decay? What has England done with this heritage?

Strictly following the principles in vogue in those days, the British Government, on assuming the protectorate of a portion of the mainland strip of the Sultan's dominions and its hinterland, handed over the territories to the Foreign Office, which kept a watch upon foreign activities, consummated treaties with ruling chiefs, protected generally, but eschewed anything like active administration. The area around the head-waters of the Nile, which we now call Uganda, was in military occupation, and connected with the coast by an expensive caravan journey of some 800 miles. The coast was looked after by the Foreign Office Consul-General at Zanzibar. The 800 miles between the two areas were unadministered outside of rifle range from the posts along the caravan road, and the passage of each convoy across the Great Rift Valley, the cattle grounds of the warlike Masai tribe, was generally an adventurous proceeding. Exports from the interior consisted solely of ivory, and the Arab slave-worked plantations on the coast yielded some copra and grain. Imports consisted mainly of groceries for the white officials, cotton cloth, and beads, and a great quantity of telegraph wire, mostly to replace the miles of the same article regularly cut down by the natives to be beaten out into spear-heads or bracelets.

But the genius of Lord Salisbury, and his study of what he, at that time, was calling large scale maps, committed England to a great piece of constructive development. The Uganda Railway will rank in the history of Empire building with Lord Strathcona's Canadian Pacific line, and Cecil Rhodes's Cape to Cairo projects.

Many reasons have been given why the Uganda Railway scheme was embarked upon. The original estimate was about 2½ millions sterling, and it was argued in the House of Commons on strict business lines. England had committed herself, at the Brussels Convention of 1890, to put down the slave trade in East Africa. To do this, the problem, like the income tax, must be tackled at the source. Hence the expensive occupation of Uganda. Leakages must be safeguarded by a naval squadron on the coast. These items cost us £250,000 a year. Hence the interest charges on 2½ millions for a railway that would destroy the slave trade at its source, and save the naval squadron, would show a saving, that is to say, an Imperial profit. The working expenses of the line were reckoned at about £40,000 per annum, and the revenue at £22,000, to be derived from carrying Government stores to Uganda at £12 per ton against £80—the caravan rate. A small revenue was expected from ivory traffic and trade goods, but a working loss was anticipated of about £18,000 per annum, certainly not much to knock off the Imperial economies that were hoped for. Beyond this, no economic results were predicted.

To some of us it may seem doubtful if the financial argument for the railway thus modestly, as it now appears, dangled before the business men of the House of Commons, was really the motif of the project. Let us look outside and see. The Uganda Railway was first mooted about 1894, when Lord Kitchener's advance on Dongola was beginning, and took definite shape in 1896, contemporaneously with the building of the desert railway towards Khartum. In 1898, when the Mahdi was smashed, the Uganda Railway scheme bounded ahead, and it began to be suggested that it might form a valuable alternative means of military access to the head-waters of the Nile should the Egyptian route be at any time closed. The unfriendliness of some of the European Powers, and especially of Germany, during the South African War, along with the not unconnected trouble in China in the year 1901, coincided with an expediting of Railway construction work in East Africa so insistent that the originally projected terminus at the deep water of Port Victoria, at the north-east corner of Lake Victoria, was abandoned in favour of the present terminus at Kisumu. This saved eighty miles of length, at least a year in time, something in money, but all to the great economic disadvantage of the railway and lake steamer traffic for many a long year—indeed, until the original line to Port Victoria is built. But the line reached the Lake in 1902, and quick communication by rail and water, from the coast to Uganda and the Nile, was an accomplished fact.

I will not stop to describe the work of construction of this line, 584 miles in length, which crosses two great mountain chains, the one over 7,000 and the other over 8,000 feet above sea-level, dives down the steep escarpments into the Great Rift Valley between them, skirts lakes well known to every schoolboy since Rider Haggard wrote his "Alan Quartermain," and traverses Nature's greatest Zoological Gardens, the lands of the blood-drinking Masai and the garment-scorning Kavirondo. Enough to say that the cost was over 5½ millions instead of the 2½ millions estimated, and that the difficulties of construction were such as to disturb the temper of even a Foreign Office official. The carriers died like flies; mules, camels, rope-haulage ways, and every other means of transport for materials were requisitioned from the Foreign Office construction committee at home. But the last straw was reached when the engineers demanded transport elephants from India. The reply of a distinguished official of Whitehall, which is not to be found in the Blue books, is said to have been, "Tell them to go and catch the animals themselves."

Meantime the Foreign Office had divided the country into two, the Rift Valley and warlike Masai forming a natural dividing line. From the coast to the Rift became the British East Africa Protectorate, thence to Lake Victoria and beyond to the Nile and the Congo border became the Uganda Protectorate. A Foreign Office Commissioner was put in charge of each territory, and something like administration began to emerge. Railway construction had brought a vast army of British Indians into the country, who followed the railway line and soon proved to the natives that skins and hides had a value in excess of their usefulness for making assegai shields, and that many captivating articles could be acquired by the natives, and especially by their wives, by the simple process of selling something they produced and did not value for something they coveted more. Railway transit made this natural development inevitable. Still, however, it is true to say that little if anything was done by the ruling authorities to stimulate this desirable process.

Some groping about the future there certainly was. The possibilities of white settlement were borne in upon Sir Charles Eliot, who sent an

informal commission to South Africa in 1902 3 to invite colonists to take up land. But it may be surmised that his idea was rather to create for political and military purposes a resident white garrison, of the type that prefers a detached existence, not necessarily lucrative so long as it enjoys the sense of land-ownership and cannot see its neighbours' smoke, rather than the more ambitious modern type, who in making money for himself makes revenue for the State. But the home policy towards the natives had not been defined. Sir Charles and the Foreign Office disagreed in public, and the former resigned. The influx of Europeans, however, continued, though the Home Government seemed to be in two minds as to whether it wanted them or not. Sir Charles Eliot was succeeded by Sir Donald Stewart, who frankly advocated the colonial ideal, and more Europeans arrived.

In April 1905, the Protectorates were transferred at home from the Foreign Office to the Colonial Office. Incidentally, Lake Victoria became the boundary between British East Africa and Uganda. The period of military occupation, of treaty making, and of economic stagnation came to an end, and the period of business began. Hopes ran high, for the Colonial Office under Mr. Alfred Lyttelton had succeeded to the traditions of Mr. Chamberlain, who had not been afraid to say that England must develop her Imperial estates.

Speaking in round figures, this is the position to which the Colonial Office succeeded. The Imperial Government had waived its right to debit interest upon the £5½ million railway. This was a fine endowment, but in any case the Protectorates could not have paid it, for, to make ends meet on the ordinary running of the countries, grants-in-aid of about £200,000 to British East Africa and £150,000 to Uganda were being contributed by the Imperial Treasury. Local revenues were trifling. About £100,000 was coming in from the native hut tax, there was something from Customs duties, and the Uganda Railway accounts were showing a profit of about £40,000 per annum, which was transferred to the credit of the British East Africa treasury. This railway profit was in part made by charging each Government department for the carriage of its materials and officials. This system is sound for accountancy purposes, but it was rather stretched when granting to certain higher officials the privilege of a reserved compartment, and then charging the departmental votes with the value of four rail fares. This hurt nobody in British East Africa, and merely created more imposing figures in the debit and credit side of the Protectorate accounts, which conveyed the idea of increasing prosperity to people at a distance. Uganda had not the same consolation, for her payments to the Uganda Railway went into the British East Africa treasury and reduced the amount that Uganda could spend on her own development. This rather anomalous state of affairs still continues.

A year later, in 1906, I visited British East Africa, German East Africa, and Uganda, on the suggestion of the then Secretary of State, Mr. Lyttelton, who asked me to get him information as to commercial and agricultural possibilities. I well recall his words: "I want traffic for the railway—something that the world wants and which shall be a staple, reliable, and increasing traffic." I can imagine our Chairman of to-day expressing the same wants for his ships that serve the East African coast.

What I found in 1906 was briefly this. The white settlers were unshakable in their belief in the land, an optimism in itself a glorious asset, for it was to see them through the hard period of try and try again. They were trying, among other things, coffee, wheat, maize, potatoes, fruit, wattle, cattle, sheep, ostriches, sisal hemp, ramie fibre, beans, cotton, tobacco, cocoanuts and rubber. Lord Delamere then, as now, stood out as the leader, afraid to tackle nothing that seemed worthy of experiment, and putting his results freely at the service of his fellow colonists. Captain Grogan investigated the forest resources of the country. An American syndicate spent a large sum in trying to extract fibre at a profit from the wild sansevieria.

In all this activity one could see the settlers' intention to create a State, something of a combination of the plantation dependency, such as Ceylon and Malaysia, and the purely colonial dominion, such as Australia and South Africa. German East Africa, which lay next door, and which had ten years' start of the British areas, owing to the German methods of forcing the pace and of free expenditure of State funds, was being developed along lines that frankly regarded the white man's output as everything, and the native as the mere raw material of labour. But there were a few in East Africa and Uganda who believed that the real gold was there, in the shape of a native population, which, take it all round, was not averse from being influenced to produce exportable commodities so long as it could do so, at any rate to begin with, in the ways it had always understood.

Some of the missionaries in Uganda, and some officials in both Protectorates, had tried the experiment of giving out cotton seed to the natives, to grow on their own lands and with their own free labour, promising them a market for the crop. This had by 1906 resulted in a harvest of some 200 bales in Uganda, worth perhaps £2,000, bought by Europeans and Indians. The proceeds were eagerly spent by the natives in buying cotton cloth and other imported goods. Mr. Ainsworth, one of the senior Provincial Commissioners of East Africa, had begun to give out seed potatoes, beans, and other seeds to the British East Africa tribes, with advice how to sow and how to reap. The Indian traders, already mentioned as spread over the land by the building of the railway, lost no time in educating the natives in the practice of selling and buying. The theory of the dignity of labour, so cold a creed in itself, became warmed by what Mr. Gordon Selfridge calls the "instinct of merchandising," which exists somewhere in the composition of most human beings. Still there was no official programme, at least none made public to the settlers and traders. One may assume that the policy of Downing Street was to give every tendency a fair run, and to trust to the genius of Englishmen in the bulk to bring out the best. The mountains were not going to labour to bring forth a possible mouse, but should a goodly offspring of the lesser hills see the light, the mountains were prepared to do fairy godmother in due proportion—or so we all hoped.

But there were three essentials that could not be left to evolve themselves, and these three are all matters of communications. The railway, a broad street from end to end of the country, had been provided at huge cost. But of side streets—that is to say, country roads—there were none; harbour facilities were equally nil; and the link with the world's markets, ocean shipping, was practically wholly foreign. I found in 1906 that though Mombasa had a sailing once a month by each of four steamship lines, one German, one Austrian, one French, and one English, the last was only a coasting boat running as far as Aden, and 93 per cent. of the exports to Europe were carried in foreign bottoms, and more than half of this in the German ships. As developments in East Africa and Uganda proceeded and succeeded, this state of affairs became one which I ventured to describe in this room at the time as being something that no Englishman in those countries could see without grave misgiving, and even a loss of self-respect. Individual Britishers were hammering out the future of the country upon the anvil of their pride in work done, but they could not provide the money for the roads. Nor were they allowed to build the harbour with private capital. And they could not put up the funds needed to make good the actual cost of keeping up a British shipping service to carry the small exports of those days. So the produce had to travel mainly by the German boats, subsidised by the German Government, and fell unavoidably under powerful influences that sought to divert these raw products of British energy to the people and the workshops of Germany. From this followed automatically the shipment of German goods in exchange, until, by the year 1911–12, the tide was setting fast between Hamburg and Mombasa. Half the population of Mombasa, the ocean port of the two Protectorates, and the railway terminus, was by then German by birth and language. The German Consul even opened a recruiting office, at which he enrolled British African natives for service in the German East Africa forces.

We have jumped to the year 1911. Let us see what was the position then. The combined value of imports and exports through the port of Mombasa had risen to 2½ millions sterling. The cotton crop of Uganda had increased from the 200 bales of 1906 to over 15,000 bales. The white settlers' coffee plantations were a proved success, though hardly in bearing to an extent that could give a surplus for export. Sheep-raising was beginning to be doubtful, ramie fibre had gone, but cattle diseases were being overcome, and grading up from local stock was looking well, and has since done better. Sisal hemp, of which our German East Africa neighbours were producing 15,000 to 20,000 tons annually (the German Navy was prohibited from using rope made from any other), was successful beyond question. Analysis of East African wattle bark showed it to carry more tannin than the best Natal product. The British East African natives, especially in the Lake and Mount Kenia provinces, were producing oil seeds, beans, and potatoes in quantity and buying trade goods freely. I happened to be passing Aden and tried to persuade an Indian merchant there, who was supplying the garrison, to get his stocks from British East Africa. His reply was, "It is no good; the people here will only eat potatoes from Nairobi." I had not a map handy to give him a geography lesson, but I was satisfied with his answer.

Larger matters had not altogether slumbered. Mr. Churchill had travelled through from Mombasa to the Sudan in 1908, and the short route to the Congo State was projected. This was to be the Busoga Railway, connecting Lake Victoria with Lake Chioga, with a steamer service on the latter to Masindi Port, a motor road thence to Lake Albert, and steamers on the latter to connect with the Congo shore. All this was to become an accomplished fact by 1913-14. In 1911 Lord Kitchener travelled through from Egypt *viâ* the Sudan, Lake Albert, and Uganda to Mombasa. Incidentally, as is well known, he became an extensive landowner in British East Africa, and his coffee plantations, cattle farm, maize-drying sheds, cattle dip, irrigation dam, and other estate developments are likely, by their influence and completeness, to play a big part in the scientific development of the country. The link established between the Sudan, East Africa and Uganda, by Lord Kitchener's tour, is suggestive, and already not without signs of significant development.

In this year also, 1911, the Union Castle Mail Steamship Company, famous for its part in the history of South African development, had commenced a service to Mombasa *viâ* the Suez Canal. It was truly British pluck to come on, without a penny of mail or other subsidy, and to challenge the German ships, albeit in a British colonial port. Should these words sound strange, remember that in our ports our Government gives equal hospitality to all. But to trade in the East African ports, the German Government was giving to its steamers a subsidy of nearly £90,000 per annum.

By the middle of 1912 things were humming, not only in the two British territories, but among our neighbours, south, west, and north. European and native developments were giving real results. The imports and exports through Mombasa exceeded three millions sterling. The Uganda cotton output was worth a quarter of a million—20,000 bales—and quantities of oil seeds, beans and other produce were being exported. Land values for European settlement quadrupled. Herr Dernburg, the German Colonial Secretary, toured through British East Africa and Uganda. He praised everything and everyone, and especially thanked Great Britain for having made it possible for the German Lake regions' produce to reach the outside world over the British railway. On no account, he declared, would Germany commit so unfriendly an act as to extend a competing line from the German coast to Lake Victoria. Then he went on to German East Africa and put in hand a survey for that selfsame railway. He expedited the extension of their main line *viâ* Tabora to Lake Tanganyika, and ordered it to reach the latter, without fail, by 1914—a significant date, which was duly kept. Herr Dernburg began to prepare the German coast port of Dar-es-Salam for the future, by providing a floating dock and other harbour facilities.

An incident about that time was a small local trouble in Zanzibar. A few discontented Arabs threatened the local authorities of the island, which was, and is, under British protection. A party of German troops arrived from their mainland opposite, offering their help to keep order. By remarkable foresight, they had started from Dar-es-Salam before the trouble in Zanzibar began. The British already had the situation well in hand, but I believe it was quite hard to make the Germans understand that they were not wanted.

In the Belgian Congo State, on the west of Uganda, the difficulties of administration in an area so remote had given opportunity for cruel and selfish conduct to some miscellaneous individuals whose hunting ground is always the country where there are fewest policemen. One can imagine that the highly-coloured and persistent reports of atrocities, which then so nearly caused ill-feeling between England and Belgium, were pleasant reading to the Wilhelmstrasse and the editors of the Wolff Bureau. Prince Albert of Belgium would no more take these matters through the eyes and reports of others than he, as King, would share by proxy in the gallant deeds of his army to-day. He just went to the Congo to see for himself. Payment in trade goods was abolished, traders were promised free entry—and have been given it—and since 1912 a steady and increasing flow of traffic of goods and persons has been passing between Mombasa and the Congo State by the route which Mr. Winston Churchill had projected four years before—the Uganda Railway, Lake Victoria, Lake Chioga, the Masindi road and Lake Albert.

Turn now to the north, where the Nile connects Uganda and the Anglo-Egyptian Sudan. The Uganda Government steamers run from Lake Albert to Nimuli. The Sudan steamers traverse the 1,000 miles of navigable water between Khartum and Gondokoro. Between Nimuli and Gondokoro occur 107 miles of rapids. But 107 miles is "across the street," when speaking of half a continent, and that obstacle cannot block

the way for long. The first step is already taken. On the death of King Leopold, the Lado Enclave, lying along the west of the Nile in this region, reverted to British rule. This area has been divided between Uganda and the Sudan, and the southern boundary of the Sudan moved south to the latitude of Nimuli. Thus the cataract section is now wholly within the Sudan administration, which will no doubt find a speedy and efficient way of dealing with it. Then will come the development of the Bahr-el-Gezel region to the west, which reproduces the features of the fertile swamp region of Lake Chioga in Uganda. Lake Chioga is now giving the Empire nearly half a million pounds' worth of cotton per annum. Would that Samuel Baker was alive to see it! Who can say what the Bahr-el-Gezel will do, with fifty times the area, before fifty years have passed? This must find its gateway through either Mombasa or Port Sudan, it matters little which.

Again follow the map round, and you find the Abyssinian frontier, with a road running north and south connecting that land of mystery with the Uganda Railway at Nakuru. Along that road pass horses, mules, cattle and merchandise. Further east, the valley of the Juba River divides British East Africa from our friends the Italians, and gives 200 miles of navigable waterway to bring their traffic to the British port of Kismayu, on the Indian Ocean, and thence by coasting boats to the ocean steamers at Mombasa —I repeat, the scheme of Tewfik has been realised, but not by Tewfik.

I have said that British East African trade had now topped the three million mark. Not only so, but the revenue of British East Africa was balancing its expenditure, and Mr. Harcourt could abolish the Imperial grant-in-aid. Most significant of all, the German steamers were now carrying away less than 50 per cent. of the produce, instead of nearly 100 per cent a few years earlier, so they increased their sailings and their Government maintained its subsidy. The Union Castle Line put on larger steamers, and ordered larger ones still, but had to ask its shareholders to pay the working loss.

But at last the British Government, which had watched so long, was to show that it had not watched in vain. The menace of Dar-es-Salam was not to go without reply to its floating dock, its feverish railway extensions to the Lakes, and its overflow of German traders into the British areas. A Governor was appointed to British East Africa, Mr. (now Sir Henry) Belfield, who had taken no small share in the creation of one of Great Britain's most successful Imperial businesses, the Federated Malay States. Mr. Alfred Lyttelton came out on a visit, and combined his holiday with shrewd observation and a determination that party politics should have no part in putting the shoulder to the wheel. Lord Kitchener went to Egypt, and the Sudan felt his stimulating presence. The East African railway system was overhauled by Mr. Blake Taylor, fresh from responsible work in India. He found that the nominal railway profits of preceding years had been largely created by using up capital, for 10 per cent. of the rolling stock of 1902 had disappeared through old age, and the rest were on their last legs—or wheels—and practically none had been replaced. The Lake ports, the main line, and the harbour of Kilindini, the port of Mombasa, were hopelessly congested. Mr. Harcourt took prompt steps, rolling stock was ordered, and the Colonial Office sent out its consulting engineer, Mr. Maurice Wilson, to investigate the harbour question, the vital link between the system of inland communications and the means of ocean transit. Both of these may be perfect, but if the bottle neck be inadequate, the traffic cannot squeeze through save at great cost and loss. Competent calculation has shown that the delays to the steamers and the damage and inconvenience to trade were equivalent to a tax of 5*s.* on every ton of import and export cargo; indeed, worse than a tax, for it is sheer waste, and goes into the pockets of nobody, and handicaps the products of East Africa on the markets of the world. No wonder Herr Dernburg was all smiles when he went on to give an extra push to Dar-es-Salam in the race for the great prize, trade predominance as the gateway for half a continent.

And so we reach 1914. The Mombasa trade was now nearing five millions sterling, and the Uganda cotton crop about 50,000 bales. The natives were enlarging their wants and buying better clothing, bicycles, cigarettes, and quantities of soap. Some chiefs even bought motor-cars; one of them bought two, for he said he had heard that in England the lady wife must have her own conveyance. In the Nyanza province Mr. Ainsworth's natives raised and sold 18,000 tons of exportable produce. The European population increased by 30 per cent. in a single year, and their coffee and sisal hemp fetched top prices at home. The Congo transit traffic was responding to the improved communication facilities. In March 1914 the new 11,000-ton steamers of the Union Castle Line

arrived at Kilindini amid great enthusiasm. The Governor, Sir Henry Belfield, announced at a dinner on board the "Llanstephan Castle" that where private enterprise had led the State must not be behind. He added that where State funds were not available for the great developments needed, private capital must be allowed to do its part. And His Excellency informed East Africa that Mr. Harcourt was about to bring in a Loan Bill in the Home Parliament, whereby three millions sterling would be provided for harbours, railways and other great public works in the East African Protectorates. The plans for Kilindini harbour were approved, and a survey put in hand for a branch railway from Nakuru. This was to cross the Vasin Gishu plateau, a thickly-settled European area, traverse the timber forests of the Ravine and open up the productive North Kavirondo native region. It is easy to foresee the natural terminus of this line on Lake Victoria at Port Victoria, the originally projected terminus of the main line. Port Victoria has 16 ft. of water, which compares with 7 ft. only at Kisumu, the present terminus. Kisumu has done great work with its 1,000-ton steamers on the Lake, but has reached its limit. The day will come when 3,000-ton boats will steam in and out of Port Victoria bay, and that place may take rank as—shall we say—the Chicago of Equatorial Africa, the collecting point for the entire Lake region and the Eastern Provinces of the Congo State.

And here let us make a simple calculation. There are fifteen million people in British East Africa, Uganda, the Eastern Congo, and the German Lake districts, for all of whom the port of Mombasa is their shortest route to the outside world. The consumption of cotton goods is the best test of development. These fifteen millions of people received in 1913 just half a million pounds' worth, say eightpence worth of clothing for every man, woman, and child for one year. In more forward regions of Africa the figure per head is three to four shillings' worth per annum —a not very extravagant millinery and tailor's bill. And other trade, import and export, goes in proportion. Reckoning nothing for the further advances of civilisation, there is thus, within assured view, a jump in the trade of those countries from the five millions of last year to something like twenty millions sterling, and it depends first and foremost upon communications. Ten million pounds' worth of food and raw materials to come each year to the people of Europe, and ten million pounds' worth of home manufactures to go out in exchange. And with trade follows the *Pax Britannica*, equal opportunity for all, and the creation of surplus revenue to lay out upon fighting climate and disease, to build schools and hospitals, and to pay for the equipment of civilisation with which the European settlers are establishing a strong and permanent colony in the area climatically suited to them.

What is needed now to reach the goal? Above all, no relaxation of effort, for nothing is so certain as that you cannot stand still. If you do not progress you go backward. The harbour must be gone on with and its present handicap on trade abolished. East African products have just such a value as they can command in competition in the world's markets against the products of older countries, the latter in their millions of tons, and we, as yet, only in our thousands. We need good ships to carry our thousands, but if they charge enough to cover their expenses our products cannot pay it, or are limited to the output of areas close to the railways and the Lakes. Reluctantly, but deliberately, I assert that the economic progress of British East Africa and Uganda has owed more to the big German shipping subsidy than to any other factor, except of course our railway. Even £50,000 per annum, and it was much more, spread over the whole traffic in the reduction of freight rates below the cost of working the ships, provides a margin upon which millions of pounds can be embarked in East African trade and development. The Imperial British Government has invested ten millions of money in the railway and in settling the country. It holds the doorway for millions of people in our own and adjacent territories. Will it not safeguard its investment and step into the breach, now that the German ships and German shipping subsidy have gone?

Then, incidentally, I would plead for a more effective realisation, in the administrative machine, of the essential unity of the areas we are discussing. The system of distinct local governments, two treasuries, two Customs departments, for British East Africa and Uganda, makes for separation rather than for co-ordination on the spot. When, for example, the whole of the railway revenue derived from the traffic of both the British Protectorates and from our neighbours, all goes into the treasury of one of the Protectorates, the other is apt to doubt its own recognition in the general scheme.

Before I close, let us look again at the map. Observe how closely Egypt, the Sudan, Uganda, British East Africa, the eastern provinces of the

Belgian Congo, and the Lake regions of German East Africa, are knit together by natural lines of communication and the last four of these countries have their doorway at Mombasa. I have tried to indicate how closely connected has been their development thus far. May it not well be that their future may take shape in some form of economic federation of North-East Africa?

[The paper was illustrated by lantern-slides lent, or produced from photographs kindly lent, by the London agency of the Uganda (Government) Railway Department, the East Africa Estates, Ltd., the East Africa and Uganda Agency and Development Co., Ltd.; the British East Africa Corporation, Ltd., and the *African World*, per Mr. Leo Weinthal and Mr. J. Auerbach. Exhibits of produce of East Africa and Uganda were lent by the British East Africa Corporation, Ltd., and the East Africa and Uganda Agency and Development Co., Ltd. The Union Castle Mail Steamship Company, Ltd., exhibited oil paintings of Mombasa harbour. The thanks of the reader of the paper, and of the Council of the Society, are gratefully accorded to all who thus kindly assisted.]

DISCUSSION.

The Chairman (Sir Owen Philipps) said that at a time like the present, when everybody's attention in the country was rightly directed to the feats of our Army and Navy, especially our Army on the Continent of Europe, one was apt to overlook the fact that there were great doings on the African Continent; first in Togoland, which had now ceased to be a German colony; then further south, the Cameroons, where the capital, Duala, was now under British control and declared open to British trade; further south still came the British Possessions, where, under the magnificent leadership of General Botha and General Smuts, the rebellion was rapidly being quelled, and the whole country was joined together in suppressing the invasion from German South-West Africa, a district which he believed would before long be added to the Union. With regard to British East Africa and Uganda, the author had very graphically succeeded in bringing into the short space of less than an hour a most excellent and lucid account of the progress and development of those countries. It was specially important that the attention of Great Britain should at present be drawn to East Africa, because the Germans had invaded that colony. It should be thoroughly understood what a very important Imperial asset East Africa and Uganda were to the Empire, and he hoped that they would not only be maintained and developed but still further increased by the addition of the neighbouring German colony.

Lady Lugard said she had no idea on entering the meeting that she would be asked to speak, and felt herself to be really quite unworthy to detain the audience even for a moment. Major Leggett had given so clear and admirable an account of the development in East Africa during the last few years that everyone had been deeply interested, and she was sure that no one would be more interested than her husband had he been able to be present. No one had taken a deeper interest in Uganda than he had, and she well remembered on first making his acquaintance that one of the most interesting things he told was how he went into Nairobi and made blood brotherhood with the chief and bought a small area, now Nairobi, thus adding the first bit of that country to the British Empire. He came back, a silent and shy young captain, to find that upon him had been laid the onerous duty of going through England and Scotland addressing crowded assemblies in order to raise a feeling in favour of keeping Uganda, and so well succeeded that the Government of that day, which had made up its mind to abandon the country, determined to hold it. That was the only sort of claim, as it were by proxy, that she could be supposed to have for saying a single word in the discussion, but she was certain she was expressing everybody's feelings when she said how much interested they had been in hearing what Major Leggett had to say to them.

Sir Harry Wilson, K.C.M.G., said he had really far less claim than Lady Lugard to speak at all upon the subject of East Africa and Uganda because he had simply been there as a tourist for a very happy three weeks, travelling up from Mombasa as far as the Lake, crossing the Lake, and coming back again with various short diversions on either side. That afternoon, in the murky atmosphere of London, it was delightful to be transported by the paper and the beautiful pictures on the screen to the sun-washed spaces of East Africa and Uganda, and the audience were greatly indebted to Major Leggett for the admirably clear description he had given of the development of the country and the wonderful possibilities which he had foreshadowed. There was one point in the paper which he wished to take up, not as one having anything to do with East Africa or Uganda, but as one concerned with the neighbouring territory of Nyasaland and the adjacent territory of Northern Rhodesia. Major Leggett had mentioned that the Imperial Government had brought in a Bill for the loan of three millions to the Protectorates, and particularly the Protectorates of East Africa and Uganda, but he believed he was right in saying that about £800,000 of that loan was to have been devoted to the neighbouring Protectorate of Nyasaland, to be spent on roads and railway extension, and it would be a very great disaster to that Protectorate, as it would be to British East Africa and Uganda, if the Bill did not become an Act. Everyone in the room interested in any of those three countries would agree with that, because the failure to raise the loan would mean a most unfortunate stagnation at a time when the Empire ought not to be standing still but carrying on "business as usual." He had felt a great deal

of envy in looking at the pictures of the Uganda Railway, because in North-Eastern Rhodesia at present there was no railway at all, and the goods so painfully produced in that part of the world had to go down to the Zambesi, over a bad Portuguese road for 220 miles, then by a long stretch of river to Chinde, and from Chinde to Durban, and so home. He wished publicly to express the great debt which the inhabitants of the country owed to Sir Owen Philipps for the kind interest he had consistently shown in meeting their efforts in that direction. He was sure Sir Owen Philipps would be glad to know that last year, in a limited part of the territory of North-Eastern Rhodesia, something like £5,000 to £6,000 worth of cotton was grown, although cotton-growing was only begun there as a commercial enterprise in 1910. That part of the country also produced a large crop of tobacco, and this year he was told by his manager that there would be a very much larger acreage under tobacco. Railway facilities were absolutely essential for that district of the country. The present meeting would be a very valuable one if, as its outcome, the three Protectorates should join together to see that they were not left out in the cold but that the Loan Bill was carried through, and he could say for himself, and he was sure he might say for his friend, Mr. Birchenough, who had had to leave the meeting, that they would only be too glad to take a part in any movement in that direction.

Mr. Alfred Wigglesworth thought the paper was of exceptional excellence, and did not think it would be possible for anyone to have given so comprehensive a view of British East Africa and Uganda in such a short space of time. The audience had gained more knowledge in one hour than they could have obtained in weeks and months of travelling throughout the country. He wished to refer to a subject with which he was familiar in connection with the development of the Protectorate, namely, the fibre business. It was only in 1906 that the first plants of sisal fibre were introduced from German East Africa and planted in the highlands and in the coral lands of the coast as an experiment. Everybody laughed at the planting of sisal in the highlands, in land so rich that it would grow almost any crop, because sisal was known to be a plant that would only thrive on coral soil or land of singular infertility. The plant, however, prospered to a degree which no one would have imagined, and the industry developed. Machinery was brought out from Germany, as that country appeared to be the only country producing a machine which could successfully prepare the fibre, and the product was sent home. The first batch arrived in London less than three years ago and realised a very handsome price, and since then the industry had increased to a point at which he estimated there were over 10,000 acres of the plant in the coast lands and the uplands, producing in the present year something like 3,000 tons of the fibre. Taking the produce of each acre as three tons and the price at somewhere about £30 a ton, the value of the sisal industry to-day was close on a million pounds in British East Africa. That was as great a monument to the energy and enterprise of the planters and settlers as any other product produced there. He agreed with all that had been said with reference to Sir Owen Philipps and the great work he had done in the development of East Africa. Without transport the settlers might produce plenty of goods, but they would not be able to market them at prices which would show a profit. That was particularly the case with such things as wattle bark, which was not very valuable per ton. The future of East Africa was largely dependent upon binding it up with the rest of the Empire by a good service of steamers, with freights reasonable enough to put the product on the home markets in competition with the products of other countries.

Professor W. J. Simpson, C.M.G., M.D., said his visit to East Africa and Uganda hardly entitled him to speak on the economic development which had been so admirably described by Major Leggett; but he naturally formed impressions, and was particularly struck with the newness of things, the rapidity of the growth of the commercial and agricultural interests of the country, and the rapid development under very great difficulties. It was only a short time ago that the inhabitants were trying to exterminate one another in inter-tribal warfare, and were the subjects of slave traders; but now the Uganda Railway stretched from Mombasa to the shores of the Victoria Nyanza, and throughout the country there were large cattle ranches and sheep farms, and the natives were raising large crops of maize and other things for exportation. There were also plantations of copra, coffee, sisal and wattle, and the immense undertaking of the Magadi soda works. Some of the inhabitants believed that Nairobi would ultimately become the hub of the universe. Across the lake, in the eastern Province, the population, which was a naked one, was growing cotton in patches from half an acre to three acres, and was transporting it to the ginneries recently established, from which it was sent away to the Lancashire mills. The peacefulness and great development of the country showed the British genius for governing native races and for pioneering work. He had travelled in most parts of British possessions, and everywhere had found German commercial travellers. He remembered once meeting an energetic British traveller, but he was travelling with whisky. The German commercial travellers were well-trained men, who went to great pains to discover what their customers required, and took care that the firms they represented sent out the things that were needed. One exception to that was the corporation to which Major Leggett belonged, because the energetic agents of that Company were always at work endeavouring to see for themselves how matters stood. He felt strongly on the subject, because it had a very bad

effect. In one of the remote places of Uganda he went into an Indian bazaar to see what goods were being sold and where they came from. Loin cloths he found came from Germany; some of the cotton goods came from America, but the majority from Austria; sewing machines came from Germany, as did also brass and iron wire so much used for ornament by the women of the country; scented soaps came from Hamburg. There were some things from England, such as bicycles and Lipton's tea. Ninety per cent. of the cotton from Uganda went to the Lancashire mills, and one would naturally think that the mills in return would supply a large quantity of the cotton cloth; but only one-fifth of the quantity imported into the country came from Great Britain. He felt certain that if the country did not wake up in a commercial respect after the war we should be outstripped by those who sent well-trained commercial travellers to the country.

Colonel C. E. Yate, C.S.I., C.M.G., M.P., in moving a cordial vote of thanks to Major Leggett for his most interesting paper, said he had never been to East Africa in his life, but he could honestly say that no one in the House of Commons voted with greater enthusiasm than he did for the grant of the three-millions loan to East Africa and Nyasaland. He was one who believed that the State should help in the development of our possessions and protectorates abroad in every possible way, and if there was one thing more certain than another it was that he should continue to back up the development of Uganda and East Africa in every possible way. He had followed the history of Uganda and the East African Protectorate since his early Indian days, and could remember well, during the building of the Uganda Railway, losing one of his best shikaris, who was sent for from British East Africa by one of the railway engineers to help him to rid the country of lions and other wild animals that were interfering with the work. He had followed the history of the country through its career to the present day, and was watching the present military operations there with the greatest interest. He was sure they would all join in the wish of the Chairman that the result of those operations would be the considerable enlargement of the East African Protectorate. It was desirable that the Protectorates should be joined together and communications opened up, and he hoped that the obstacles that had hitherto been placed by the Germans in the way of that grand idea of Cecil Rhodes of a Cape to Cairo railway would be before very long entirely removed. Colonel Yate, on behalf of the Society, also thanked Sir Owen Philipps for presiding.

Sir Frederic W. R. Fryer, K.C.S.I., seconded the motion. He said he had never been to East Africa or Uganda, but he had often heard Major Leggett's name in connection with those countries, and had taken a great interest in their development. He felt sure that everybody present had been in no way disappointed in their expectations of learning a good deal from the paper which had been read that afternoon.

The motion was carried unanimously.

Major Leggett, in reply, said it was a great honour to him to hear the kind words of Colonel Yate and Sir Frederic Fryer, and to receive the appreciation which the meeting had so kindly given to him. He was very thankful for the interest that had been taken in a subject on which he and others interested in the country felt very deeply. With all that had been said in the course of the discussion he thoroughly agreed. There was a great deal to be done not only by Governments but by individuals.

Mr. Maurice F. J. Wilson, M.Inst.C.E. (of Messrs. Coode, Matthews, Fitzmaurice and Wilson, Ltd., Consulting Engineers to the Colonial Office), writes:—The Colonial Office are quite alive to the necessity of deep-water accommodation at Kilindini, and towards the latter end of 1912 they requested my firm to report upon the whole question. Consequently, I went out early in 1913 in order thoroughly to investigate the site and obtain particulars with a view to preparing the necessary report. The site at Kilindini proved to be an excellent one for the purpose. It offered a large area of deep water, perfectly land-locked and sheltered, where deep-water quays could readily be constructed in direct communication with the main line of the Uganda Railway. Extension to such quays could be made as the requirements of trade called for them. A report to this effect was sent in to the Government, and it is hoped that the work may be proceeded with as soon as circumstances permit.

EIGHTH ORDINARY MEETING.

Wednesday, February 3rd, 1915; George R. Parkin, C.M.G., LL.D., D.C.L., Organising Secretary of the Rhodes Scholarship Trust, in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Buckland, James, 28, St. Thomas's-mansions, Westminster Bridge, S.E.

Khan, Choudhri Md. Aziz-ulla, Sahawar, Etawah, U.P., India.

The following candidates were balloted for and duly elected Fellows of the Society:—

Bailey, Hollis Russell, 19, Congress-street, Boston, Massachusetts, U.S.A.

Barnard, George E., Park Estate, St. Lucia, British West Indies.

Brandt, Richard Frederick William, B.A., 5, The Boltons Studios, Fulham-road, S.W.

Cherry, Albert, Venezuela Central Railway, Caracas, Venezuela, S. America.

Cottingham, Walter H., Woolley Hall, Maidenhead, Berks; and The Sherwin-Williams Company, Cleveland, Ohio, U.S.A.

Duke, Sir (Frederick) William, K.C.I.E., C.S.I., 11, North-street, Westminster, S.W.

Harris, William A., A.M.I.Mech.E., St. Lucia Usines and Estates Company, Ltd., Castries, St. Lucia, British West Indies.

Heynes, James Baylis, British Vice-Consul, Messina, Sicily.

Hume, F. Charles, Jun., First National Bank Buildings, Houston, Texas, U.S.A.

Lloyd, Professor John Uri, Phar.M.Ph.D., LL.D., 3901, Clifton-avenue, Cincinnati, Ohio, U.S.A.

Lovett, Major-General Beresford, C.B., C.S.I., 59, Madeley-road, Ealing, W.

Morgan, Edward D., 170, Summer-street, Boston, Massachusetts, U.S.A.

Perkin, Dr. F. Mollwo, F.I.C., F.C.S., 199, Piccadilly, W.

Powell, Christopher Charles, 52, Langdon Park-road, Highgate, N.

Power, John Joseph, K.C., M.A., LL.M., D.C.L., P.O. Box 532, Halifax, Nova Scotia, Canada.

Shaw, George L., Antung, Manchuria, China.

Watson, F. Mackman, "Selwood," Rotherham.

Wood, George, 626, Chestnut-street, Philadelphia U.S.A.

The paper read was—

EXPANSION OF BRITISH INDUSTRY AFTER THE WAR.

By Octavius Charles Beale,
Past President of the Australian Manufacturers' Association.

Our chief subject for consideration to-day will be the methods by which may be attained that expansion of industry throughout the British Empire which is the aim of all loyal citizens. We shall not attempt to adduce in exhaustive form the countless spheres of activity which may and ought to be included in our future efforts, and whilst indicating some of them we shall suggest the direction of our energies so as to tend to a comprehensive result. Even in the territorial sense there will be acquired through the Great War further fields for enterprise, but we have also to reconquer lost or undeveloped domains in the area of manufacturing industry itself.

Britain the Mother of Invention.

You have all heard to nauseation that our British industrials, employers and employed, lag far behind the foreigners—more especially our esteemed friends the enemy—in respect of technical education. Our workers, forsooth, in their ignorance, indifference, indolence, above all by their trade unions and combinations, are spoiling everything. You were told upon authority the other day that the Germans have succeeded over the English because "they know all that there is to be known" in what they undertook. Yet our nation has taught the world!

Authors, poets, philosophers, acclaim this by common consent to be the Iron Age. Very good, who started and developed it?

In the past, sagacious statesmen, brave and faithful generals, invincible admirals, upheld the honour of our race, made stable the Imperial sway, and spread over all the world the glamour of the British name—wider far and even more glorious than the *Romani nominis umbra.* Soldiers, sailors, statesmen, not merely traders, built up the British Empire with the indispensable assistance of the assiduous inventor and the patient industrial at their back, at home. Thus the second Abraham Darby, of Coalbrookdale, in the former half of the eighteenth century, was the first man effectively to smelt iron with coal in the form of coke, instead of charcoal. His son built in 1767 the world's first iron bridge, which, spanning the Severn, has withstood for a century and a half the stress of traffic and the storms of time, and so these brown-coated Quakers in their earnest simplicity became the true founders of the Iron Age, and in high measure of their country's greatness. Yet their very names, and those of their compeers are all but forgotten by the world at large.

At the end of the seventeenth century the first Abraham Darby, having started a brass foundry, had devised means for making articles out of iron that had been usually made of bronze. He also invented a method of casting hollow-ware in sand, and so became in quietude and obscurity an epoch-making personality. Some day, perhaps, a superfluous and voluble politician will be lifted off an undeserved pedestal so that one or other of these genuine empire-builders may be given his due.

Britain, not Germany, Leader in Technical Instruction.

We all know how steam-power was practically introduced and developed in Great Britain, how railway enterprises fought down opposition, how ninety years ago road-cars not ineffectively driven by steam were crushed out of existence by adverse legislation, how the use of electricity was developed, and electro-plating made practical

—and all in England. We know who laced the earth with marine cables; who advanced mining and metallurgy all over the planet; who applied chemistry and extended the purely scientific knowledge of it; who discovered aniline dyes; who built and drove the first steamers around the globe; invented spinning and weaving machinery, sheet window glass, and lighthouses; who also practised well-sinking, irrigation, acclimatisation, stock-breeding on a planetary scale; who improved wheats, and who carried on exploration of the waste places of the earth. We know, too, who can justly claim the change from wood to iron, and from iron to steel in shipbuilding. Our British people of all ranks of society were either first or foremost in each of these and other departments of activity, the very enumeration of them dazzling the mind.

And we know now how the well-armed and well-armoured German plagiarist, who has been called "the Chinaman of Europe," succeeded against Englishmen in England, whose vain boast has been that they had no industrial protection, very little military but far too much naval!

How Germany Stole Marches.

Well, then, if there be defect in the technical instruction to our workers, if there be default in the due reward to and encouragement of industry, together with that adequate furtherance and protection by legislative measures which Germany and all the important foreign nations enjoy, blame must attach to others than those who have suffered. The favourite attribution, as already said, is not to those who have withheld the benefits, but to the workers who have been thus deprived of opportunities so freely and generously provided everywhere outside of Great Britain. To ignore this phase of the subject would be, at least to oversea residents of the British Empire, to shut our eyes to the *fons et origo mali*. To-day we cannot enter upon the arguments *pro et contra*, for that must be left to our public men.

It is not to be feared in Greater Britain across the seas that industries, the people's only sound and sure means of livelihood, will be left to what has been called the "free play of natural forces." These are in essence highly artificial, and have been seen on occasion to consist of cunning with capital applied to the destruction of competing activities. Aggregations of both have controlled by varied methods departments of industry outside the producing States themselves. We have witnessed the spectacle of a German private firm debauching by bribes high officers in Japan so as to secure business in iron and steel products intended for civil and military use in the Japanese Empire. An intensely patriotic, sensitive and self-denying people felt themselves outraged when, by a chance, discovery was made. Justice was done, and righteous anger was aroused against the Germans which is not soon or easily to be appeased. Such commercial forces, however, are seen to be natural enough, or artificial enough, just to the extent that prepossessions will leave our vision clear. The firm alluded to was shown to have a carefully organised department for the acquisition of business, *fas et nefas*, and a stupendous capital. The incubation of a world-war might not be beyond its dreams.

It is no small matter that the metal products of an important mining field, like Broken Hill, the chief source in the world for zinc, and prolific in lead and silver, should be controlled by Germans resident in Germany. And so with other British mines that yield abundantly. By cables we are informed that the Commonwealth Government has tackled the question with the resolve to have the treatment of Australia's concentrates, hitherto shipped to Germany in quantities of several hundred thousand tons per annum, dealt with in the country of production or in Great Britain. From whatsoever type of neglect, political or personal, but at all events national, the British Empire has let slip in very large measure control of this stream of wealth.

How to Keep the Money in the Family.

British industry will expand after the war beyond doubt, but it is incumbent upon us to "apply our minds keenly to consider" the channels for expansion before the war closes, because the rush and demand, according to experience after other great wars, will be so great that preparations for new work will be costly to the extent, perhaps, of exclusion. Here, then, in metals is a sphere for present action.

Canada.

In some countries there are placed export duties upon ores to the end of securing that the handling shall be done in the producing country itself. The effect of such a provision is, *inter alia*, that the refined metals are available on the spot for use separately, or with admixture of others. Canada produces her own iron and steel, and to obtain the highest qualities, or kinds suitable to

special purposes, she must have chemists and metallurgists with the major and minor metals immediately at their disposal. Hence she can obtain as citizens men who are most advanced in applied science and can fully remunerate them. Their activities, besides teaching others, require collaboration in diverse branches of work and of instruction, to the huge benefit and strength of the Dominion. Where a country itself derives the chief advantage out of its own productions, there may surely be expected an expansion of them, especially those which, like metals, are basic to other industries. So in Canada, apart from gold, the metal and mineral production during five years up to 1912 shows a gratifying increase. The grand total for 1912 was $133,000,000, an increase over the preceding year of $30,000,000, say 26¾ millions and six millions sterling respectively. And Canada, as you are well aware, uses discrimination in every just form in the political treatment of her industries, so that they may be made remunerative and attractive to her citizens and to would-be immigrants.

As to the manufactures of Canada, comparing the year 1910 with 1900, the consequent increase is enormous, not to say startling, for the figures have much more than doubled. In the decade they have been raised from £96,000,000 to £233,000,000, or an increase of over 142 per cent.

Australasia.

Turning, then, to our other colossal Dominion across the seas, the Commonwealth of Australia, we find that our imperial industries proceed upon similar lines of development. There, too, all kinds of discouraging prophecies were hurled at advocates of the expansion and differentiation of industry, prophecies that now are seen to be so absurd and humiliating to their authors and propagators that it is unkind to mention them. A great coal-producing country, Australia imported coke for her mining and metallurgical industry. Customs duties were proposed and imposed, with the usual howl from vested interests. There are now long rows of coke-ovens, and the fuel is cheaper, of course, than ever. It is known to be a grazing country of some importance, with a practical monopoly of merino wool, and depasturing (if we include New Zealand) just twice as many sheep as the whole of the United States of America. On the coast-lands dairy cattle luxuriate. But the Commonwealth imported preserved milk from Switzerland, and when duties were proposed on canned milk, prophets within my own hearing set up a pitiful lamentation about the cruelty to babies. Vested interests again. But the *soi-disant* Swiss packers have now extensive factories in Australia, whence they export canned milk to many countries, and of an absolute purity that is controlled by the State, whilst the babies have not gone short for an hour. The preserving element is Australian-grown sugar.

It is safe to say that no controversy has been more prolonged and embittered in Australia than that of growing cane and manufacturing sugar by white labour exclusively. Yet the coloured labourers have been as far as possible repatriated, and whereas in 1906 the quantity of sugar produced by them was over 100,000 tons, in 1913 it was only 6,000 tons. As that has declined towards vanishing point, so the total product has been raised until it reached last year nearly 250,000 tons, and, as we see, by British activities. Again the prophets were confounded, and a powerful demonstration made of the efficiency of British brain and brawn. Rest assured, ladies and gentlemen, that even in this sphere of action there remain further areas for progress, that the severity of the work will be reduced by devices and contrivances, whilst it may fairly be claimed that in the department of chemistry as applied to sugar production and waste-saving therein, Australia is not surpassed. In conquering that field the Empire is served directly and handsomely.

A few years ago an English expert upon wheat-growing surprised his hearers in this very room by telling them that tilling and harvesting in Australia were conducted at a lower cost than in any part of the world. Yet we all know that the remuneration of labour is there happily high. It was a frequent prophecy, settled by political economy to methodical and irrefragable proof, that the Australian colonies could never become grain-exporting dominions in competition with India and Russia. As chief objection, the states embraced by the geographical term Australasia were so sadly British and possessed of the idea that workers should be well paid. Only when wages should fall, as they surely would, to the European level could they hope to enter the market. As we all know, these obstinate British were not guided by professors of political economy, have never been so guided in the very least, but set themselves to think all afresh, just like their brethren and forefathers for ages. They did not even consult the allegedly profound thinkers of Germany, as

they might. No, the problem was, with little means but much faith in themselves and love of their race, how to conquer those glorious domains by sheer industry whilst facing Nature in her most appalling austerity. They invented the stump-jumping disk-plough and the stripper harvester—with other tools—so that they also, as we started by saying, helped to teach the world.

But I read in the Chicago papers, when in that city a few years ago, that the big harvester combines of America had resolved that the agricultural implement factories of Australia must become mere repairing shops for American-made machinery. Left to the free play of natural forces (or artificial as aforesaid) that is exactly what would have occurred. By all purely philosophical and high economic argument of the political variety, those producers of useful tools, with further ever-impending novelties of invention in Australasia, would have been wiped out of existence. The farmers would thenceforward become vassals of the American exploiters. The proposition was for the exploiter only too sweetly simple. But the electors and their parliamentary representatives decided otherwise. They preferred to preserve and to expand the industry. Consequently Australian implements have had a very large sale in Argentina, in North, South and Central Africa, to the benefit of the Empire and the world. There remains one highly important improvement yet to be perfected. We are told that progress is being made towards the completion of an agricultural implement which will plough, cross-plough and harrow in one operation, leaving the land ready for the seeder. The extra power demanded is expected to be but slight, and that remarkable attainment will also be the product of British brains under a rational and genuinely scientific industrial policy.

Canadian agricultural machinery is to be found in use in quantities probably far larger than Australian all over the Empire, thanks to the determination of her men of enterprise and her legislators. Else, as all Canadians know, their country would be a mere appanage of the United States.

Foreign Monopoly of British Metals.

On December 10th, Mr. W. M. Hughes, Federal Attorney-General, speaking in the Commonwealth Parliament, said that "the investigation regarding the Broken Hill and other metal companies had not disclosed an offence against the law, but the facts showed, beyond all question, that German influence exercised a monopoly over the civilised world's base metal industry. The monopoly was so complete that it excluded effective competition.

"Peace held out no prospects satisfactory, or even tolerable, to the British and Australian interest, since it would only revive complete domination of the industry. The war would have been vainly waged, if, when victory at a dreadful cost had been won, we were again compelled to pour into Germany's lap the lion's share of the wealth created by Australian enterprise and Australian workmen.

"Germany determined, in effect, our mineral output. The position was intolerable. The Commonwealth had communicated with the Imperial Government strongly requesting co-operation in these matters, in which the interests of the Commonwealth and the Empire were so vitally involved."

Whether all this is illustrative of, or antithetic to, the glorious principle of *laissez-faire* and the free play of natural forces, must be left to the dialecticians to settle. Casuistry brings no cash to the honest workers, nor strength to the British Empire. The price of freedom is eternal watchfulness, plus keenly elaborated protection to our toilers by head and hand, as against their exploiters, be they German or American bankers and metal-jobbers, or both combined. The two in combination has been the actual condition of affairs. Whether a world-war counts among natural or artificial forces is also hard to say, but assuredly it has laid bare infamous machinations and has shattered what were thought to be impregnable commercial strongholds. It is in the power only of a people's combine—that is to say, a national government—to prevent their re-erection. Where a government actively intervenes by well-chosen measures the exploiter lays his snares in vain.

How Malaya Teaches the World.

Take the instance of a little State where the article involved is yet of Imperial, indeed world-wide, importance. Counting their chickens before they were hatched, the German-American metal-jobbers purchased lands in suitable positions to deal with the tin-product of the Malay States. It is as much as that of the rest of the world added together. All arrangements had been made with customary skill and audacity to exploit the producers—and, of course, the consumers. But the Government of the Malay States quietly yet firmly

entered the field, imposed differential duties upon the metal contents of the ores, to the effect of retaining the industry locally, and, further, of retaining control for the public benefit. Smelting works, the largest in the world, were erected by a British company at Singapore and Penang. In these works are smelted not only the local products, but to them are consigned tin ores from South Africa, some from Australia, and a good deal from the Dutch Colonies, for treatment. Seeing that the game was up, the poor German-American bankers were constrained to arrange for the sale of their lands, which were eventually taken over by the Government of the Malay States, which altogether is a very fine example of able British administration. Here let me interpolate that my own business friends who have come into contact with them find no words too emphatic to express their admiration of these able and courteous British officers, faithfully discharging their duties and dealing out to all an even-handed justice. Our people having built well, their structures withstand the earthquakes of Armageddon. But we can do more work on the same lines, as I hope to show, and on a comprehensive scale.

How to Throw Off the Foreign Incubus.

For some years past we have pressed upon the Government of Australia the advisability of inducing the local treatment of ores by placing export duties upon the metal contents, whilst allowing free export of the refined metals. I have myself co-operated with our Chambers of Manufacture and with Associated Trades Unions in the effort to localise the industry and thereby to remove it from foreign control. We collated and presented all the facts and figures, but our deputations to the then Federal Ministry received only the cold shoulder, so that the Germans remained in possession of the field. Not at all that these exploiters were intentionally favoured, but because false arguments prevailed. Take one for the sake of its significance as applied by our people all the time, and most of all in the homeland itself. *Ex uno disce omnes.* The Germans, we were told, could do something that we British in Australia could not do, nor for the matter of that the British in Britain either. And so the melancholy fact remains that the whole of the concentrates from the biggest mining field of the world in zinc, lead and silver have been sent to Germany for treatment. Further, the ore-contents, the metals themselves, were controlled—as the phrase goes—by Germans. In other words, they got the handling of the profits. Nor does the trouble end there, because the contracts for the sale of the ores, properly called concentrates, continue after the probable end of the war. Can a position be more wholly ridiculous, inasmuch as neither Germans nor Germany are held bound by laws, conventions or even sworn contracts under seal by their rulers ?

The thing we British could not do was, however, in the physical sphere. Very high temperatures are required in the treatment of the concentrates, and no British firebricks would resist them. But the manager of the largest company informed us that his people instituted a careful search for the material in Australia, which continent seems to possess every metal and mineral. The company purchased an area containing the desired clay. They had bricks prepared of it, after preliminary experiments, then placed a German brick on top of an Australian brick, subjected the two to extreme heat, and, finally, fused the German brick right over the British, leaving the latter unaffected. As before said, from one German lie learn the lot.

Australian-born metallurgists have developed to an amazing extent the saving of metals by floating them to the surface instead of depositing them. Where does the German omniscience come in that has been so unfairly and unwisely forced upon our acceptance of late ?

Once the legal minds have finished their important discussions as to how we can, and why we ought to, restrain ourselves by contracts which the other side regards as scraps of waste paper, it will be up to Great Britain or Australia, or both, to institute the smelting and refining of the metals already named. Meantime the Straits Settlements and the Malay States, as also New Caledonia and Canada, not adhering to the shibboleth of *laissez-faire*, or the supposed impropriety of the State interfering with "natural" forces, have made themselves—their citizens—quite comfortable. That the German-American banking and metal syndicates prefer their victims to be bound by the fundamental principle of political economy goes without saying. National economy, however, gets along much better when free to institute its own devices, and to adjust itself to the visible exigences of varying situations.

The Beneficence of Industry.

Abraham Lincoln declared, in a speech to his constituents: "No doubt you have all heard a great deal of the political economists. I

don't know much about them myself, because I don't read them; but this I do know, that when America sends a thousand dollars abroad for iron rails she gets the rails, but if she makes them herself she has the rails and the dollars too." That is true, but the apophthegm does not describe all the benefits by a long way. An important department of mining operations for metals is the production of chemical fertilisers, so that miner and farmer mutually assist one another. So, too, the flour miller returns the bran with its phosphoric acid to the stockowner, thus indirectly tending to sustain the fertility of the soil. Consequently, it is worth something, and worth much to a country, to establish, to preserve and to protect its individual industries, for hardly ever do they stand alone. All are more or less interdependent, of which countless illustrations can be supplied.

Not merely in the basic industry of metal-refining does the United Kingdom under stress of war find herself strangely deficient, but also in dye manufacture, of which we have heard so much. There again will dye-production not only train and remunerate a large number of chemists of first rank and other skilled employees, it will contain a department for the manufacture of drugs, beneficial and otherwise, besides stains and colours. Engaged in the utilisation of what was a waste product, it may well develop other savings, but in any case it will be a centre of invaluable practical instruction. All that is worth something, as advocated by the great consumers of dyes in Great Britain, namely the protection and preservation of the industry.

Dangerous Draughts through an Open Door.

Gathering now our threads together, we have seen that, without Teutonic boastfulness and bumptiousness, our nation has been in the past the world's great industrial inventor and instructor. Under the industrial policy introduced by Bismarck in 1879, which set out to found and further German industries in all departments, a stupendous success has been achieved. In iron and steel production Germany has distanced Great Britain, left her out of sight, greatly surpassing her even in iron and steel exports. John Bull, who professed to love the bracing breezes of competition which blew through his open door, has found them of late icy as Antarctic blizzards. The remedy is simple: shut it! All other nations, without exception, and his own Dominions oversea, keep their doors open, shut, or ajar, just as suits their own comfort and convenience. It is not *laissez-faire* practice by any means, but it is rational and it works unexceptionably well. Each a master in his own house, the brethren cling affectionately together, the reverse of what *laissez-faire* economists prophesied and hoped. All of these brethren are resolved to exclude the foreign scheming monopolist, as they are resolved now and hereafter to fight in phalanx the common enemy whencesoever he may come. Bismarck in 1879, or shortly before, in commending his policy, said that Great Britain would stick to her free-import *régime* for fifty years, say 1929, but he did not foresee the Great War.

Reform of Patent Laws.

German companies domiciled in Germany, in association with companies registered in England under German or other names, use our law courts to fight purely English concerns so as to restrain them from certain manufacturing methods. That is the outcome of *laissez-faire.* With our eyes open we grant a monopoly to foreign foes (commonly called "enemy aliens" in utter disregard of grammar), and thus encourage boundless energy in attacking our own industrials. Firstly, that procedure damages the national and Imperial interests, for a suit may and does relate to articles of urgent necessity in war and useful in peace. Next, it gravely affects artisans, and, finally, the work and profits of industrials. German companies, with British branches constituting juristic persons according to the sweetly attractive fiction, may not even introduce German capital, they may simply borrow British money to fight Britons. Everybody knows that, but there is no representative body to attack the evil and with clamant voice to demand its suppression in the name of common-sense.

German and other foreigners, inimical or not, readily obtain British agents in any part of the Empire, with capital of the agents' own and what they can borrow, to distribute the foreigners' manufactures. Freed from all local taxation they earn profits for the foreigner, often under harsh and arduous conditions whilst subject to displacement, in violent and even deadly antagonism to the British producer and employer of talents and labour. Chambers of Commerce cannot interfere with that kind of thing without compromising their own *raison d'être.* But manufacturers' associations exist primarily to defend British industry and to help against foreign aggression. The functions are absolutely opposed, so that no man,

nor corporation, can serve two masters—*Aut unum sustinebit, aut alterum contemnet.* Our British press is splendidly national, and rests its claims for changes upon ultimate demonstration; but where at present is the public body to supply it with authenticated facts as to the nation's producers, their interests, their dangers and their hopes? When there is a public wrong to rectify, or a national gain to be made as against vested foreign interests, the story must be oft repeated by the Press ere the needed change be effected.

Imperial Free Trade Impracticable.

The Oversea Dominions never have proposed, and are certain not to propose, free interchange within the Empire. Each is striving earnestly and loyally to develop to the utmost its own resources, whilst favouring the Motherland in such manner as the several Parliaments consider practical. Each Dominion seeks to diversify and to expand its industries with due regard to local conditions and probabilities. Thus where it suits Canada to establish textile industries in cotton and linen, it is highly improbable that Australia, New Zealand and South Africa will introduce them. Assuredly each dominion will decide such points for itself. We have not space to extend the illustrations, but that just adduced may suffice. And here I wish to submit a proposal with a view to the development and increased solidarity of Imperial industry after the War.

A Movement for Solidarity.

In Canada and in Australia are provincial societies of industrials, usually incorporated, denominated in the former country Manufacturers' Associations, and in the latter Chambers of Manufacture. In each Dominion there is a central body, forming a union of the several provincial societies, which deals with matters of federal interest. It affords an opportunity to the delegates to consider and to make recommendations upon national matters as persons skilled in their own sphere and representative of important national interests. In Australia, at least, industrial courts settle the one question of difference between employers and employed, the payment and conditions of labour. That settled, all the interests of the people engaged are at one, consequently in industrial matters manufacturers' associations represent large sections of the community—in Canada 520,000 employees, in Australia 340,000, besides much larger numbers dependent upon these.

My proposal is that there should be formed in Great Britain, in like manner, manufacturers' associations solely to represent producing interests, apart from those of distributors of foreign-made goods. As things stand in Great Britain industrial interests are affected, and possibly on occasion overborne by the purely commercial. Importers and manufacturers are inextricably mixed in the Chambers of Commerce, although there are, curiously enough and in contradiction to their own general principle, Chambers of Commerce in purely manufacturing towns and districts. Even with these the representation cannot be so clear and authoritative as if they were directly and solely chambers of manufacture representing the national interests of producers. A merchant with half a dozen clerks—I know of cases—supplies in Great Britain foreign-made articles in competition with British manufacturers of similar goods. With interests in complete antagonism, both sets of people are included in chambers of commerce. Yet in replacing the goods brought from abroad we might well provide incomes for British workers to the number of hundreds of thousands. Even the merchants' six clerks are countervailed, because still more English clerks would be required to keep account of the English manufactures. Surely, then, it is desirable that those who do employ English artisans should join in distinctive associations to consult over their common national interests and to make recommendations to the authorities tending to the wealth, strength and progress of the nation.

At present, the Manufacturers' Associations of Canada and the Chambers of Manufacture of Australasia are excluded from Congresses of Chambers of Commerce. It is altogether right and proper that they should be so excluded, because the interests represented by associations primarily of importing traders are those of a comparatively small number in any British community. On the contrary, citizens represented in their industrial life by Manufacturers' Associations are numerically many hundredfold greater. Moreover, in respect of national defence and stability, they are incomparably more important. In Australia, pastoralists, farmers, mine-owners, ship-owners, manufacturers, merchants and retail traders have, each separately, their own consultative and representative body, well organised. The resultant benefit to the entire community does not require explanation.

Industrials are Imperialists.

It would follow upon the formation, however small at first, of manufacturers' associations in Great Britain, that their colleagues and brethren from overseas will quickly desire connection with them. Their aim is quite sure to be Imperial strength and development of British industry all over the world. It cannot be denied that with the merchant it is largely *ubi bene ibi patria*, but the industrial is rooted to the soil. From his very circumstances and in point of observed fact, the manufacturer is profoundly and energetically nationalistic; he has travelled widely and is compelled to keep himself *au courant* with the work of the world in his line. His view of mankind goes beyond his till. He does not hold it to be the chief end and aim to buy cheap and sell dear. He does not admit the glory or the wisdom from the national view-point of buying in the cheapest market and selling in the dearest. He holds it to be lofty sagacity in the national legislature to apply itself in all ways to see that the people at home get incomes, have the local field for industry held open for them and preserved to them, that the national prosperity be broad-based upon good wages and reasonable conditions to the exclusion of "sweated" goods from abroad. He sees that other countries are rid of grinding poverty, and holds that Great Britain can get rid of it too without expropriation of anybody.

Fair Trade is Bonny Trade.

An eminent exponent of *laissez-faire* and of a twelve-hour day for children, to whom statues have been erected in England, declared that he would not oppose the practice of adulteration of goods because it was a form of competition. Unquestionably it is so. Having been twice president of the largest Chamber of Manufactures in Australia, as also twice the president of the Associated Chambers, occupying the chair at the formation of the latter body, I am able to speak for the men that I hold so much in honour. Without a dissentient voice they voted for, year by year, and urged upon the Government, preference to Great Britain. They have upon all occasions, and during a long series of years, declared for absolute purity in the official food-standards. They have declared for truthful labels. They have passed resolutions repeatedly, and presented them to the ministries of the day desiring the prohibition of false and fraudulent medicines and alleged cures. Action was taken by the Legislature for the benefit of the innocent and the ignorant, so that numerous fraudulent drugs are prohibited in Australia which are still actively sold and advertised in Great Britain. True, a Select Committee of the House of Commons has recently condemned these very drugs, following a report presented in Australia, but the committee's report has been indefinitely shelved. In the face of strong representations from important and independent public bodies, with a large block of votes at their back, or in the very near distance, legislators are seldom supine. You cannot expect traders to take action, because the drug-packers themselves have a special section in Chambers of Commerce to protect their very solid interests against adverse legislative action.

Family Education.

Manufacturers exchange information as to processes, methods, improvement of installations and novelties in practice. Especially our American and Canadian friends are remarkably broad-minded and handsome in that regard. On the other hand, I have frequently read notices in German trade papers warning their constituents that such-and-such a foreigner, naming him, was in Germany, might be seeking information, and to be sure to close their factories against him. But the Germans were, all the same, apt and ardent students whilst accepting American hospitality. The greater the intercourse and fraternal meeting by industrials from all parts of the Empire the greater will be the solidarity. Fields of operation will be discussed, whilst always and everywhere there will be devised schemes and plans for Imperial advancement along the solid line of industry.

I have spoken chiefly of Australia and Canada as being prominent examples of oversea Dominions, but with no intent of ignoring the others. In the vast Indian Empire, in our immense and continuous African Empire as the war will leave it, we have to prepare for mighty development. How can we do better than place the unofficial initiative in practical and practised hands? If we had a Manufacturers' Association of the British Empire it would be active, sound and conservative in the best sense. You want for that cool and able men, not starry brilliants. But they must be unafraid of shibboleths, men who will use all honourable means that can be found, without regard to party or the feelings and ambitions of party leaders.

Harvests of Empire.

Long ago it was said of the Spanish Empire that upon it the sun never set. We have become

heritors of the epigram, but more wonderful is the fact that in the *orbis terrarum* of the British nation there is a ceaseless round of harvests. When shearing of wool ends in one Dominion, it is beginning in another. When apples are ruddy in the orchards of New Norfolk, the air is heavy with perfume of the blossoms in Quebec. In greater or less altitudes, in higher or lower latitudes, all round the planet, there is such gradation of the seasons that gathering of crops, the same kind of crops, proceeds uninterruptedly from January to December. In Greater Britain there is diversity of land and climate, but in the minds and hearts of the citizens a family likeness. As it is better expressed in the exquisite lines of Ovid :—

Facies non omnibus una,
Nec diversa tamen, qualem decet esse sororum.

DISCUSSION.

The Chairman (George R. Parkin, C.M.G., LL.D., D.C.L.), in opening the discussion, said he did not think anything could be more certain than that when the war was over we should be living in a world which was new in a very great many particulars—new in its outlook, new in the relations of nations, and new in the relations of individuals—and perhaps there was no sphere in which that would be more true than in that of commerce. Anyone who had seen the marvellous progress which Germany had made, in the last twenty years particularly, must have been struck by one great fact, namely, that in that country's industrial and commercial development there had been a close association of Government, of finance, and of private and individual effort. Each had played into the hands of the other, and he could not help thinking that it was a great lesson to British people, who had entirely relied and leant upon private effort to the exclusion of that collaboration which the Germans had devised between those other two great forces to which he had just referred. He would not touch upon the argument that there should be a mutual preference in every part of the Empire for the products of every other part, but he desired to point out that after the war was over the different parts of the British Empire would have, and indeed were already having, secured to them, a preference greater perhaps than they could have obtained under ordinary trade conditions. It was impossible for him to think, after the Songs of Hate which we heard from the Germans, that in the future German commercial men would be able to manage their business in English-speaking countries with the same ease that they had heretofore done. Therefore there were going to be new and vast openings for British industry; and more than that. All the nations of the world were going to emerge from the conflict exhausted, and never in history would it be so necessary to have mutual consideration existing in a great Empire like the British Empire between the Government, financiers, and private individuals. In every matter the nations would have to face the work of building up new business. In such a condition of affairs, all prejudices which might be held by people in certain directions as to how trade should be conducted, should be swept aside, and the matter approached with open mind. When the war was over there would have to be a great consultation between the public men of the British Empire—not only statesmen, but business men, manufacturers, traders, and shipowners. He had said that we were going to be exhausted. That would depend somewhat upon ourselves. It would be remembered that when France was crushed in the war of 1870, and when she had to pay £200,000,000, apparently every Frenchman determined to live on as little as he could, and tried to produce everything he could to sell to somebody else, with the result that within a few years France was a richer nation than she had ever been before. That course was open to us also, and we must not fall back into our *laissez-faire* habit. There would have to be a clean and a clear consideration of all great industrial questions. The economy which was being practised in the country to-day would have to continue after the war. He believed that the huge sums which were being subscribed for philanthropic purposes at the present time were really saved by the economy of the people in their ordinary living. There was one more remark he desired to make. Another curious condition would emerge as the result of the conflict. In addition to being the greatest naval power in the world, we were also going, much against our wish, to be a great military power, with the result that we should have an increased world-wide influence. That was going to lay upon the Empire great responsibilities. There would be new opportunities, new fields for work, and we should have new moral and material weight in every corner of the world; and in order to be able to discharge those responsibilities aright, and to maintain the strength which was given us in that way, we should have to take new lines. The British Empire was finding itself to-day as it never found itself before. It had been found that the various parts of the Empire could work together as a united force all round the world, each one doing its own share with enthusiasm, extreme willingness and spontaneity. Our statesmen would not be doing their duty if they did not organise those vast forces of enthusiasm which had been put in motion. Men of great imagination and great power, in commerce as in politics, were required to grapple with the question. In that way, in addition to the Empire emerging from the struggle a greater naval and military power, its industry and commerce would have a still greater future, and would be given a security greater than it had ever had before.

The Hon. Sir John McCall, M.D. (Agent-General for Tasmania), said the paper, which

reminded the audience of all the work which had been done by our forefathers in establishing industries and in giving to the world a culture which it did not possess before, certainly served as a tonic, and it was well that people should be reminded that the position of the world was largely due to the work of Britishers; and although some of the fruits of that work might have been stolen from us by the astuteness or the thieving propensities of our enemy, it should always be remembered that what Britishers made in the first place could be taken back. The Colonies had always endeavoured to give preference to the manufacturers of Great Britain, but that preference was taken away by the acts of some people in this country. In some cases English ships carried manufactured goods to the Dominions from Germany at a considerably less cost than freights of English manufactured goods. By so doing they were robbing the manufacturers of Great Britain of the benefits of that preference which the people of the Dominions were so anxious to extend to them. There was a great deal to be done in the matter, but it could not be settled at a public meeting; it could only be discussed behind closed doors by selected men. He believed it was absolutely essential for the future of the Empire that at the close of the war there should not only be a formation of Imperial Chambers of Manufacturers, but also a gathering of Imperial statesmen from every part of the Dominions in order to decide what was the best thing to be done for the future of the Empire and its permanency.

Sir Boverton Redwood, Bart., D.Sc., F.R.S.E., said there was one feature of the subject to which recently he had had occasion to pay some little attention, and that was the present position of the zinc-lead question, and he felt very strongly that some decisive action was in the highest degree necessary. He hoped due attention would be paid, by those who had the opportunity of dealing with that question authoritatively at the present time, to the statements which had fallen from the author. Probably the statement was not exaggerated that in respect of Australasia that question was of greater importance than was the aniline dye industry in respect to this country. He would go further, and say that whatever might be the importance of that question to Australia, it was in a sense of even greater importance to us as a matter of principle that we should take advantage of the present opportunity of helping Australia to take, or of taking ourselves, that which never ought to have gone to Germany. Therefore in that particular matter there was a direct responsibility resting upon those in this country who were dealing with it.

The Hon. J. G. Jenkins (late Agent-General for South Australia) said he appreciated everything the author had said, although he did not entirely agree with all his conclusions. With reference to the mineral industry of Australia, the Germans had something in their minds, when they arranged the contracts with Broken Hill and all the other mines for the supply of metal to the German companies. Those contracts contained a clause specifying that they should be continued even if suspended during war—a provision that no English company, as far as he knew, had ever put into a contract at all. He was not sure, but he did not think the Commonwealth Government had yet passed legislation actually to nullify the existing contracts, but he understood they were prepared to do that on the understanding that something would be done to furnish a market in this country for the purchase of the outputs of those mines. It was well known that when war was declared, and the output of the mines stopped, 20,000 people were immediately thrown out of employment, and it was only after a reorganisation that work was resumed. What did that mean? It meant that for years Australia had sent hundreds of thousands of pounds' worth of minerals to Germany; that the Germans had employed tens of thousands of men to turn that metal into products, and that then they had supplied them to various parts of the British Empire. Really Australia had furnished the raw material to Germany for that country to employ its labour and increase its wealth. He thoroughly agreed with the suggestion that there should be a convention of statesmen and business men held after the war to discuss all vital matters connected with the trade and commerce of the Empire.

Sir Edward Durand, Bt., C.B., said as far as he could see, Great Britain had never troubled herself about her trade abroad. It was also quite impossible, or had been hitherto, to get financial aid from the Government in the starting of any new process or business, whereas with Germany it was quite the contrary.

Mr. J. M. Fells said the paper had interested him particularly because it dealt, amongst other things, with a science of which he had been a humble student, namely, that of economics. The author had quoted in that connection a significant passage by Abraham Lincoln, which reflected very much the habit of mind of many people with regard to economics. The author himself was not quite of that school, because he had himself adopted the tenets of the German economists in many ways, and had practically advocated what might be called "national economics" as opposed to "general economics," or political economy. In that connection it had to be remembered that, if the national economic system were adopted, one must admit that fiscal rules and regulations were not of universal application, and that which might be a good code of fiscal regulations for Australia, with its large continent and rich minerals and great natural advantages, might not be the best for a small island like Great Britain.

The author was practically admitting the whole principle of economics when he agreed there were such things as national economics; and it had to be remembered in that connection that unless it were admitted there was such a thing as economic science, and, if the theory of foreign exchanges was ignored altogether, one was driven back to the position of a village community producing all its own things by itself, self-contained and self-satisfied —in that way all commercial and financial progress being marred and prevented.

Mr. E. T. Scammell said reference had been made several times to what would happen at the conclusion of the war. It did seem to him that steps to deal with the matters raised by the author and others should be taken not after the war, but in preparation for the close of the war, because when hostilities were concluded so many political and other difficulties would arise that some of the most important matters which had been discussed that evening would be relegated to some far distant date.

Mr. W. F. Leeson remarked that the great fact had to be faced that for forty years Germany had built up an enormous trade. He agreed with the Chairman that that had only been possible by the combination of the German manufacturer, financier and Government, and it could not be too deeply impressed upon the people of Great Britain that such a combination was needed in this country in order to capture trade.

On the motion of the Chairman a hearty vote of thanks was accorded to the author for his valuable and interesting paper.

The Author, in reply, said that Mr. Jenkins had dealt with the question of the Broken Hill Mine and how the Germans held that trade. They had obtained it by foresight in making contracts over a large number of years, and also they had certain processes of which they were not the inventors, but of which they had possession. His Free Trade friend would no doubt consider that that was perfectly right, but he personally considered it was absolutely wrong for an Empire to allow its inventions to go to outsiders, who were thus enabled to employ thousands of men, who were supported by their Governments and who took full advantage of the Free Trade system whereby their articles were carried in British ships at a lower rate than British goods were carried over a less distance. It was astonishing. Taking copper, the largest copper refinery in the British Empire was in Australia, and yet the output was controlled by Germans. It was for the Government to see that such things did not occur again. He agreed thoroughly with the suggestion that something should be done before the end of the war, which no doubt would be a time of great mental and commercial turmoil.

ENGINEERING NOTES.

Sydney Harbour Bridge.—On January 8th these columns contained an outline of the proposed Sydney bridge and city railways. Further particulars have now been received of the former structure, which will rank third in the world in importance, the Forth and Quebec bridges coming first and second. In some respects, however, the Sydney bridge surpasses them, being 170 ft. high while they are 150 ft. only. The bridge will consist of nickel steel cantilevers, supporting centre girders, also constructed of nickel steel. The anchor or shore arms are each 500 ft. long, and the harbour or cantilever arms 520 ft., while the central suspended span is 560 ft. The main piers supporting the cantilevers are placed 1,600 ft. apart, centre to centre. The total length of the steel work is 2,600 ft. Provision is made between the main girders for four lines of electric railway, and a roadway 35 ft. wide. Outside the main girders on the eastern side is a motor roadway 18 ft. wide between the handrails, and on the western side a footway 15 ft. wide. The main girders are vertical and 94 ft. 6 ins. apart. The central suspended span of the bridge will be level, with grades of 1 in 39 on either side. A headway of 170 ft. above high water is provided for the central span of the bridge, whilst a headway, not less than 156 ft., is provided over the whole fairway. The upper and lower chords are braced against the wind. The trusses of the central suspended span are 100 ft. deep between centres of chords, the chords being parallel. The depth of cantilevers at the towers is 270 ft. between chord centres. The web systems are of the Warren type throughout, all main members being inclined. Panels are subdivided, and there are minor supporting and stiffening members. The method of erection will be to construct the anchor arms on false work after the main and anchor piers are completed, then build out the cantilever arms, making direct use of the anchor arms for support. The suspended span would also be built out by the cantilever method, the construction from both sides meeting at the centre of the bridge. On completing the suspended span, the cantilever connections will be freed, so that the span will act as an independent truss supported on the ends of the cantilevers. The floor systems, with the exception of the main cross girders, are to be constructed of carbon steel. This was found to be desirable in order to minimise secondary trusses due to the deflection of the various girders, etc. The higher unit stresses of nickel steel would cause greater deflections than would be the case for carbon steel members, other things being equal. Since the webs, etc., of most of the girders are decided by minimum allowable thickness of metal rather than from stress considerations, the use of nickel steel would in this case be an unwarranted expense. The floor, owing to the magnitude of the bridge and its variety, is very important. The railway tracks are carried on three stringers throughout the bridge. An intermediate

system of floor beams is placed upon the stringers, and on these floor beams rest built troughs which carry the rails. The rails are fastened to longitudinal wooden sleepers inside these troughs. The upper flanges of the troughs are braced at appropriate intervals, and there is a general covering of ½ in. steel plate over the whole railway tracks. The flooring of the main roadway will consist of wood blocks, or rock asphalt, carried on coke concrete, having a minimum thickness of three inches above buckle plates. The buckle plates are carried on rolled joists placed on longitudinal plate girder stringers. The motor roadway is designed for lighter motor traffic, and has a wearing surface of one inch of rock asphalt carried on coke concrete with buckle plates, as in the main roadway. The footway also has buckle plate flooring, with a wearing surface of one inch of rock asphalt, there being a filling of coke concrete, levelled with the top of the buckled plates.

A Searchlight of Moderate Range.—The introduction of the concentrated filament incandescent lamp of the gas-filled type is ushering in a new era in the field of reflector lighting. It is well known that the nearer a light source approximates to a point at the focus of a lens or reflecting mirror, the more powerful become the coalescing rays along the axis, and in some of the latest electric incandescent headlights and small searchlights for railway, military and industrial service, this principle is taken advantage of with remarkable effect. With the expenditure of what are in reality only trifling amounts of electrical energy, properly equipped lamps are now coming from the manufacturers which are likely to set a new standard in special lighting, and it behoves the contractor seeking to illuminate construction jobs at night economically along concentrated lines, to look into the developments in this field.

The Development of the Submarine.—Though experiments in the building of submarine vessels go back many years, dating from 1620, their actual appearance as ships of war is only of recent date. Within the last few years the development of this branch of the service has been rapid, and France particularly has added many submarines to her navy. The British Admiralty first decided on submarines in 1900 when Lord Goschen was the First Lord. After carefully surveying the position, the Admiralty sent to America and decided that the type of submarine invented by Holland was the best. The inventions were purchased, five Holland boats were built, and since that time improvement has followed improvement, but the most noteworthy feature of recent years has been the successful development of the Diesel oil engine, with a corresponding increase in the size of the vessels.

High-speed Electric Locomotives.—During the year, sixteen high speed electric locomotives have been placed in the main line passenger service of the New York Central Railroad. This type of locomotive, states *The Railway News*, is claimed to be the most powerful electric passenger motor thus far constructed, and is capable of continuously hauling a train of fourteen steel Pullman cars at a sustained speed of sixty miles per hour. With lighter trains the maximum speed of these locomotives is eighty-five miles per hour. The electrical features of these locomotives are generally the same as in the original ones first operated by the company eight years ago. The new locomotives weigh 132 tons, and the great increase in capacity, compared with the comparatively slight increase in weight, is due to the fact that motors have also been placed on the axles of the leading and trailing bogie truck wheels, thus avoiding all dead weight, all the wheels being driving wheels, and the entire weight of the locomotive being thereby available for producing tractive effort or drawbar pull. Further westward, on the Chicago, Milwaukee and Saint Paul Railway, a contract has been let for the electrification of 113 miles of track, presenting several points of interest. According to *Electrical Engineering*, overhead conductors are to be used with a direct current contact line pressure of 3,000 volts, with flexible catenary construction and pantagraph collectors. Power will be supplied to the sub-stations —which will be equipped with synchronous motor generators—at 110,000 volts three-phase 60 cycles, from water-power stations of the Montana Power Company. Very large and powerful locomotives will be used, constructed in two permanently coupled units, each having eight driving wheels and a four-wheeled bogie at the ends. The driving axles are arranged in pairs upon a series of four articulated trucks, two under the main frame of each unit. Each driving axle is twin geared to a 375 horse-power—continuous rating - motor, and the motors are permanently connected in pairs in series. The whole vehicle weighs 260 tons, of which 200 tons are available for adhesion, and the starting drawbar pull is 89,000 lbs. The passenger locomotives will haul an 800-ton train at 60 miles per hour on the level, and the goods locomotives will haul a 2,500-ton train up a one per cent. grade at 16 miles per hour. The control provides for regenerative braking. The plant and locomotives are being supplied by the General Electric Company, of America.

OBITUARY.

William Ewing.—The death of Mr. William Ewing, of the Mains, Giffnock, took place at Bournemouth, on January 9th, at the age of sixty-three.

Mr. Ewing was the second son of the late Mr. William Ewing, silk manufacturer, of Glasgow, and was educated in Glasgow and in France. In 1876 he founded the firm of Messrs. William Ewing & Co., Ltd., of Glasgow. He was also for

many years secretary, and subsequently a director of the African Lakes Corporation, Ltd. He took a deep interest in African affairs. In 1885 he attended the Berlin Conference on the partition of Africa in the interests of Nyasaland, and subsequently interviewed King Leopold with regard to developments in East Africa; and at the time of the Arab aggression in Nyasaland in 1891, he took a leading part in arranging for supplies to carry on military operations. He was present at the first conference of the directors of the African Lakes Corporation with Mr. Cecil Rhodes, and had a great deal to do with the extension of British South African rule over the territories north of the Zambesi.

Apart from his business activities, Mr. Ewing devoted a great deal of time and energy to scientific and charitable work. He served on the council of the Royal Scottish Geographical Society, and he was an active member of the Central Dispensary, and a director of the Anderson College Medical School. He was also honorary treasurer of the United Free Church College Student's Book Scheme, and of the Barotsiland Mission in South Africa. The restoration of Iona Cathedral was due in no small measure to his personal efforts.

He was elected a member of the Royal Society of Arts in 1902.

NOTES ON BOOKS.

INDUSTRIAL HISTORY OF MODERN ENGLAND. By G. H. Perris. London: Kegan Paul. 1914.

In his introduction the author says that his purpose has been "to outline the facts and to interpret the spirit of the economic history of Great Britain in the last hundred and fifty years." This purpose he has certainly carried out, for he has been content with a mere summary of the facts, while he has devoted a great deal of care and skill to an elaborate exposition of what he considers to have been the spirit which has animated and guided industrial progress in England during the last century and a half. Mr. Perris's views may not unfairly be summarised as those of Arnold Toynbee brought down to date and developed in accordance with the teaching of Henry George. Many of the admirers of the gifted author of "The Industrial Revolution" must have wished that a longer life had been granted to him, since the experience of advancing years might have led him to take perhaps a wider—a less one-sided—view of the subject which he treated with such brilliant insight. His followers have for the most part, clever as many of them are, shown even less capacity than Toynbee to realise that great social problems are not best treated by violent advocacy of one set of doctrines and violent abuse of all others. This, of course, is about as true of one party as of another, though the reformers, the iconoclasts, the pullers-down, are of necessity somewhat more violent than those who are more satisfied with existing conditions, more anxious to preserve than to destroy. The ancient Aristotelian ideal of moderation (*σωφρυσύνη*) is out of date, and so is Plato's advice, "*τὸ μέσον αἱρεῖσθαι καὶ φεύγειν τὰ ὑπερβάλλοντα ἑκατέρωσε.*"* Nobody sets any store on "the mean" nowadays, for salvation is only to be found in the extreme.

Mr. Perris is no friend for moderation. He is a strenuous advocate of the views of Toynbee, Henry George (with whose views, by the way, Toynbee was not in accord), William Morris, and the Fabian Society, and says as much in his introduction. The discussion of those views would lead into stormy regions. It may suffice to say that Mr. Perris states the opinions to which he has been led with much cleverness, and with commendable fairness. Whether his readers agree with him or not, it is a distinct advantage to all students of the subjects to have one side of the case stated by so strenuous an advocate. Mr. Perris has evidently studied the history of invention, for his facts seem to be stated correctly, though only the barest summary is given, and it is the social and political aspect of his subject which really attracts him. The contents of the book may be appreciated from his own (or his publisher's) summary:—"Three chapters are devoted to the period before 1832, when the influence of the economists may be said to have commenced. The subjects dealt with in the subsequent chapters include, among others, the First Factory Acts—The New Poor Law—The Chartists — Employment and Education — The Completion of Free Trade — The Trade Union Compromise—The Collapse of Agriculture—The Sweating System—Population and Wealth—Unemployment—The Minimum Wage—Invention in Manufacture, etc." The last chapter is entitled the "New Age," and of it it may suffice to say that it was obviously written before the war.

THE CONDUCT OF AND PROCEDURE AT PUBLIC AND COMPANY MEETINGS. Third (Revised and Enlarged) Edition. By Albert Crew. London: Jordan & Sons, Ltd.

The British public are so much attached to public meetings that the majority of them have a general and hazy notion of the lines on which they should be conducted, and so long as a meeting runs smoothly and harmoniously such a notion is generally sufficient for practical purposes. But when amendments begin to be moved, and that mysterious entity, "the previous question," is hinted at, many a worthy chairman, who has not made a special study of procedure, is apt to feel the ground slipping from under his feet. There is, then, a need for a compact manual such as Mr. Crew's volume, and the fact that it has now reached a third edition proves that its value has been appreciated. The author deals very simply and thoroughly with the whole question of the conduct of public meetings, from the methods of summoning them to the various complicated questions that may arise at meetings of shareholders.

* Plato, Republic, 619 A. "To choose the mean and shun excess on either side."

British Journal Photographic Almanac, 1915. (Fifty-fourth issue.) Edited by George E. Brown, F.I.C. 1,068 pages. London: Greenwood & Co.

This bulky volume makes its appearance a little later than usual this year, affected, no doubt, by the cause which upsets all our arrangements. But it is as complete and useful as ever, and will be welcomed as usual by the numerous professionals and amateurs who regard it as their photographic Bible, the compendious directory to which they turn for all general information. The two principal articles are "Methods of Enlarging," by the editor, and "Photography with the Microscope," by Dr. Duncan Reid. Besides these there is the usual chronicle of photographic events, descriptions of the year's inventions, with formulæ, tables, lists, and the innumerable odd bits of information likely to be wanted by photographers. More than half the book is made up of advertisements, and this half is quite as useful as the other, for it provides a really valuable directory of photographic dealers of every sort. As a mere matter of curiosity it may be mentioned that the titlepage is to be found in the middle of the book—on page 351, as a matter of fact—if anybody wishes to consult it.

GENERAL NOTES.

Bank Gold Reserves.—Speaking at the general meeting of the London City and Midland Bank last week, Sir Edward Holden stated that the bank held, as a reserve, the sum of 8 millions in gold in its own vaults. In case of necessity, he declared, they would have no hesitation in placing their gold at the disposal of the Bank of England. This might be taken as his answer to the other joint-stock banks which have declined to follow his example in stating the amount they hold, and which have pleaded that it was more patriotic at this juncture to keep their reserve at the Bank of England. During the crisis the London City and Midland voluntarily sent to the Bank of England an additional 2½ millions in newly-coined sovereigns. In his opinion there must be in the hands of the other joint-stock banks at least 50 millions in gold, and he is unable to understand their hesitation to show it in their balance-sheets. Another point of interest was his reference to the rumours last August associating his bank in particular with the complaint made by Mr. Lloyd George that some bankers were not doing their duty in financing the trading community. Sir Edward was able to produce a letter from Lord Reading assuring him that no allusion had been intended to the London City and Midland Bank, and to cite the instructions given to all its branches to be liberal in meeting every legitimate demand for advances.

African Wild Beeswax.—The trade in wild beeswax is constantly increasing in most of the African colonies, especially Gambia, Gold Coast, Nigeria, Angola, Sudan, Uganda, British East Africa, German East Africa, and Mozambique. A few years ago the exports of wax from these countries were almost insignificant, but now (according to M. E. Michel, the author of an article on this subject which appears in the *Bulletin Agricole du Congo Belge*) it amounts to thousands of tons. Wax occupies the third place in the export trade of Angola, which exports every year 600 or 700 tons of wax, while Mozambique exports about 100 tons, and Portuguese Guinea 50 tons. In 1911 German East Africa exported over 800,000 lbs., of the value of £40,000. The wild wax, when well purified, is comparable to European wax.

Groynes and Sea Walls.—The *Surveyor* of January 29th contains an interesting article upon this subject by Mr. A. T. Walmisley, who read a paper on the port of Dover before the Society a few years ago, and who has had great experience in dealing with works for the prevention of shore erosion. The secret of successful work, he says, is to connect groynes at the top end with a sea wall, to carry them well out into low water, to construct them only sufficiently high to retain the beach and not to obstruct the rush of water over the beach, and to provide them with an inclination of top edge parallel to the storm angle of the beach, which, upon the south coast, is known to be 1 in 10. They should be placed, approximately, at an angle of 95° to the flood tide, or at 85° from a shore, running parallel thereto, and at a distance apart equal to the distance of low-water mark from the upper sea wall at their top end. Groynes placed at angles more acute with the shore may secure the beach from scour on their lee side, but they assist the run of the sea in removal of the shingle on their weather side, as they do not afford "pocketing" for the beach. The article is illustrated with some valuable elevations and plans.

Aircraft for the Italian Army.—The French journal, *La Liberté*, states that some experiments with a new powerful type of aeroplane, which it terms a "super avion," have been made at the military aerodrome at Vizzola-Ticino (Lombardy), and have given satisfactory results. These trials have been conducted with a certain amount of secrecy. The new machine, the design of an Italian engineer, Signor Caproni, is provided with three independent rotary motors of 100 h.p. each. Carrying a weight of 500 kilograms (nearly half a ton), it rose to an altitude of 2,000 metres (6,560 feet) in twenty minutes. With a load of 1½ tons it attained a speed of 120 kilometres (75 miles) per hour. It is capable of remaining in the air for twenty-five hours. It carries a quick-firing gun. The machine is protected with armour. Two other craft of a similar type are being constructed, one of 600 h.p. and the other of 1,000 h.p. They will be heavily armed.

Water Hyacinth as a Fibre Producer in Indo-China.—As a result of the spread of the water hyacinth (*Eichorina crassipes*) in the waters of Cambodia and other parts of Indo-China, there has been an investigation in that colony as to possible uses the plants could be put to as a means of clearing the rivers for navigation. In connection with the discussion a French professor has announced to the Chamber of Commerce at Saigon the results of experiments he has made with the plant as a fibre producer. He has extracted the fibre from the stalk by means of a Ducheman machine, and finds that after drying, preferably by gradual process, it can be made into serviceable rope and twine as well as coarse thread suitable for matting and sail cloth, and its use in Indo-China particularly is possible in bags for rice and other grain exports in place of the jute bags now imported. On a native loom it affords a strong flexible cloth of about the same quality as jute. The fibre takes dye readily and has high tenacity. Its weight is about the same as that of jute, but can be reduced by treatment with chrome alum, which makes the product waterproof.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock (except where otherwise announced):—

February 10.—F. Vincent Brooks, "British Lithography in 1915." Carmichael Thomas, Chairman of the *Graphic* and *Daily Graphic*, will preside.

February 17.—Arthur Wilcock, "The Decorative Textile Industries and the Designer's Relation thereto." Sir Charles Waldstein, Litt.D., Ph.D., will preside.

February 24.—W. J. Ashley, M.A., M.Com., Ph.D., Professor of Commerce in the University of Birmingham, "The Economics of the War." The Right Hon. Sir George Houston Reid, G.C.M.G., D.C.L., K.C., High Commissioner for the Commonwealth of Australia, will preside.

March 3, at 4.30 p.m.—William Poel, "Shakespeare's Profession." Sir Squire Bancroft will preside.

March 10.—J. W. Gordon, "Patent Law Reform and the War."

March 17.—H. M. Thornton, "The Industrial Uses of Coal Gas."

March 24, at 4.30 p.m.—Lady Lugard, "The Work of the War Refugees' Committee."

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

February 11.—Captain Sir George Duff Dunbar, Bt., I.A., "Tribes of the Brahmaputra Valley." Lieut.-Colonel Sir Francis Younghusband, K.C.I.E., LL.D., D.Sc., will preside.

March 18.—Lieut.-Colonel A. C. Yate, I.A. (retired), "The Indian Army."

April 15.—Perceval Landon, "Basra and the Shatt-ul-Arab."

May 13.—M. M. S. Gubbay, I.C.S., "Indian Trade and the War."

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

March 2.—David Lindsay (of the Elder Scientific Exploration Expedition, etc.), "The Northern Territory of Australia: Past, Present, and Future."

May 4.—S. Chas. Phillips, M.S.C.I., "The Empire's Resources in Paper-making Materials."

Dates to be hereafter announced:—

Thomas Worthington, "The Work of the Commercial Intelligence Branch of the Board of Trade."

T. Thorne Baker, "The Industrial Uses of Radium."

Frank Baines, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

E. W. Hulme, "Patent Law."

D. Y. Cameron, A.R.A., R.E., "Etching."

Roger Fry, "Post Impressionism in Design."

C. H. Sherrill, "Ancient Stained Glass."

A. S. E. Ackermann, B.Sc., Assoc.M.Inst.C.E., "The Utilisation of Solar Energy."

Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

Augustus Vernon Harcourt, D.C.L., LL.D., D.Sc., F.R.S., "On an Economical and Smokeless Grate, and on the Measurement of the Efficiency of Open Grates."

Cantor Lectures.

Monday evenings, at 8 o'clock:—

M. H. Baillie Scott, "House Building—Past and Present." Three Lectures.
March 15, 22, 29.

David Sommerville, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.
April 26, May 3, 10, 17.

FOTHERGILL LECTURES.

Monday evenings, at 8 o'clock:—

PROFESSOR VIVIAN B. LEWES, F.I.C., F.C.S., "Motor Fuel." Three Lectures.

Syllabus.

LECTURE I.—FEBRUARY 15.—*Petrol.* Its production and properties — The composition and grades of petrol — Transportation, storage, and distribution — The dangers of petrol — Calorific value, and how far it is a basis for comparison— The properties essential in a good motor fuel— Vapour tension and fractionation as indicators of the value of a petrol—Supply and demand.

LECTURE II.—FEBRUARY 22.—*Petrol Substitutes.* (*a*) Definite; compounds — Benzol and alcohol. (*b*) Mixtures—How far mixtures of heavier grades of petroleum with spirit can be used. (*c*) The "cracking" of heavier fractions of petroleum into spirit—The researches upon which such processes are based, and their teaching.

LECTURE III.—MARCH 1.—"*Cracked*" *Spirits.* The effect of degree of temperature used—The use of water or steam—Surface action and its supposed effect—Processes in use—The utilisation of gases in solution to increase vapour tension—The steam engine *versus* the internal-combustion engine for motor traction—Conclusions.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEBRUARY 8...Engineers, Cleveland Institution of, Corporation-road, Middlesbrough, 7.30 p.m.

Brewing, Institute of (London Section), Imperial Hotel, Russell-square, W.C., 8 p.m. Mr. H. Boot, "The Production and Use of Steam in Breweries."

Surveyors' Institution, 12, Great George-street, S.W., 8 p.m. Discussion on Messrs. J. G. Head and J. Bury's papers on "The Report of the Land Enquiry Committee on Urban Land Tenure."

Geographical Society, Burlington - gardens, W., 8.30 p.m. Colonel P. Molesworth Sykes, "A Seventh Journey in Persia."

TUESDAY, FEBRUARY 9...Electrical Engineers, Institution of (Scottish Section), 207, Bath-street, Glasgow, 8 p.m. Professor M. Maclean and Messrs. D. J. MacKellar and R. S. Begg, "Distribution and Rise of Temperature in Field Coils."

(Manchester Section.) Liverpool, 7.30 p.m. Professor E. W. Marchant, "Conditions affecting the Variations in Strength of Wireless Signals."

Sociological Society, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 5.15 p.m. Professor A. J. Herbertson, "Some Sociological Geographical Problems of the War."

Asiatic Society, 22, Albemarle-street, W., 4 p.m. Professor A. A. Macdonell, "The Development of Early Hindu Iconography."

Royal Institution, Albemarle-street, W., 3 p.m. Professor C. S. Sherrington, "Muscle in the Service of Nerve." (Lecture III.)

Civil Engineers, Institution of, Great George-street, S.W., 8 p.m. Mr. F. D. Evans, "Engineering Operations for the Prevention of Malaria."

British Decorators, Institute of, Painters' Hall, Little Trinity-lane, E.C., 8 p.m. Mr. C. A. Klein, "Some Chemical and Physical Aspects of the Decorator's Art."

Photographic Society, 35, Russell-square, W.C., 8 p.m. Annual General Meeting.

Zoological Society, Regent's-park, N.W., 8.30 p.m. 1. Mr. G. Aylmer, "Exhibition of Skins of Mammals from Sierra Leone." 2. Mr. E. Heron-Allen, "Exhibitions of Skiagraphs of Foraminifera." 3. Mr. H. G. Plimmer, "Reports on the Deaths which occurred in the Zoological Gardens during 1914." 4. Mr. E. G. Boulenger, "On a Colubrid Snake (*Xenodon*) with a vertically movable Maxillary Bone." 5. Dr. W. Nicoll, "A new Liver-Fluke from the Kestrel."

Pharmaceutical Society, 17, Bloomsbury - square, W.C., 8 p.m. 1. Professor H. Llewellyn Smith, "Acetylsalicylic Acid." 2. Professor H. G. Greenish and Dr. Alan E. Beesley, "Discolouration of Sodium Salicylate in solution by Alkalines."

WEDNESDAY, FEBRUARY 10...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. F. Vincent Brooks, "British Lithography in 1915."

Electrical Engineers, Institution of (Local Section), The University, Birmingham, 7.30 p.m. Mr. N. Shuttleworth, "Polyphase Commutator Machines."

(Yorkshire Section.) Bradford, 7 p.m. Professor E. W. Marchant, "Conditions affecting the Variations in Strength of Wireless Signals."

Biblical Archaeology, Society of, 37, Great Russell-street, W.C., 4.30 p.m. Dr. Gaster, "Samaritan Phylacteries and Amulets."

Literature, Royal Society of, 20, Hanover-square, W., 5 p.m. Professor M. A. Gerothwohl, Lecture on "Comparative Literature."

THURSDAY, FEBRUARY 11 ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4.30 p.m. (Indian Section.) Captain Sir G. D. Dunbar, "Tribes of the Brahmaputra Valley."

Cold Storage and Ice Association, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. H. H. Stockfeld, "The New Reform System of Ice Manufacture and Refrigeration."

Royal Society, Burlington House, W., 4.30 p.m.

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

African Society, Whitehall Rooms, Whitehall-place, S.W., 5 p.m. Mr. H. Birchenough, "Some Effects of the War upon British and German Trade in Africa."

Royal Institution, Albemarle-street, W., 3 p.m. Dr. P. Chalmers Mitchell, "Zoological Studies. War and Evolution — Nations as Species." (Lecture I.)

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mr. J. G. Broodbank, "The Port of London and its Docks."

Optical Society, at the Chemical Society, Burlington House, W., 7.30 p.m. 1. Annual General Meeting, 2. Discussion on "Sight Testing."

Child Study Society, 90, Buckingham Palace-road, S.W., 6 p.m. Dr. C. W. Kimmins, "With the British Association in Australia."

Electrical Engineers, Institution of, Victoria-embankment, W.C., 8 p.m. Professor E. W. Marchant, "Conditions affecting the Variations in Strength of Wireless Signals."

Art Workers' Guild (Junior), Queen's-square, W.C., 8 p.m. Mr. L. Weaver, "Monuments and Memorials."

University of London, University College, Gower-street, W.C., 5.30 p.m. Monsieur C. Poupeye, "Belgian Art." (Lecture IV.)

FRIDAY, FEBRUARY 12...Royal Institution, Albemarle-street, W., 9 p.m. Dr. W. S. Bruce, "Recent Advances in Oceanography."

Physical Society, Imperial College of Science, South Kensington, S.W., 8 p.m. Annual General Meeting.

SATURDAY, FEBRUARY 13...Royal Institution, Albemarle-street, W., 3 p.m. Dr. H. W. Davies, "Emergency Music." (Lecture II.)

Journal of the Royal Society of Arts.

No. 3,247. VOL. LXIII.

FRIDAY, FEBRUARY 12, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 15th, 8 p.m. (Fothergill Lecture.) PROFESSOR VIVIAN B. LEWES, F.I.C., F.C.S., "Motor Fuel." (Lecture I.)

WEDNESDAY, FEBRUARY 17th, 8 p.m. (Ordinary Meeting.) ARTHUR WILCOCK, "The Decorative Textile Industries, and the Designer's Relation thereto." SIR CHARLES WALDSTEIN, Litt.D., Ph.D., will preside.

Further particulars of the Society's meetings will be found at the end of this number.

INDIAN SECTION.

Thursday afternoon, February 11th; LIEUT.-COLONEL SIR FRANCIS YOUNGHUSBAND, K.C.I.E., LL.D., D.Sc., in the chair. A paper on "The Tribes of the Brahmaputra Valley" was read by CAPTAIN SIR GEORGE DUFF DUNBAR, Bt., I.A.

The paper and discussion will be published in a subsequent number of the *Journal*.

CANTOR LECTURES.

The Cantor Lectures on "The History and Practice of the Art of Printing," by R. A. PEDDIE, Librarian of the St. Bride Foundation Typographical Library, have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Royal Society of Arts, John Street, Adelphi, London, W.C.

A full list of the Cantor and Howard Lectures which have been published separately, and are still on sale, can also be obtained on application.

EXAMINATIONS.

Two examinations in all three Stages (Advanced, Intermediate, and Elementary) will be held this year, the first in March and the second in May. The March examinations will commence on the evening of Monday, March 22nd, and continue till March 31st. The last day for receiving entries is February 22nd. The May examinations will commence on the evening of Monday, May 10th, and continue till May 19th. The last day for receiving entries is April 9th. In the County of London the Elementary Examinations only will be taken in March and the Intermediate and Advanced Stages only in May. The London County Council Education Committee will receive the entries for the examinations in the County of London not later than February 20th and March 20th respectively.

COVERS FOR JOURNALS.

For the convenience of Fellows wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1*s.* 6*d.* each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

A meeting of the Indian Section was held on Thursday, January 21st, 1915; The RIGHT HON. SIR HERBERT MAXWELL, Bt., F.R.S., in the chair.

THE CHAIRMAN, in opening the meeting, said it was his privilege to introduce the reader of the paper, Mr. Elwes, to the audience, and he felt peculiar pleasure in doing so, because he knew the author was exceedingly competent to deal with the subject he had chosen. A man had no business to talk about anything that he did not know, and it, therefore, became important to inquire how a man was to acquire knowledge. The answer to the question would, he thought, be found in the vocabulary of the ancient Greeks. When a Greek wanted to say, "I know," he said, *οἶδα*, which was the preterite tense of the verb *εἴδω*, "I see." Therefore, when he said "I know," he

also said, "I have seen." Mr. Elwes, far travelled, had seen many things that few present could ever hope to see, and he, therefore, knew a great deal more than most of them. He would now call upon Mr. Elwes to read his paper.

The paper read was—

NEPAL.

By Henry John Elwes, F.R.S.

I must commence by saying that it is with some reluctance that I consented to give some account of a recent visit to this country, because, except from a naturalist's point of view, I can add little or nothing to what is known by those who have been there; because it is impossible to form correct opinions on a country of which such a very small part has been visited by Europeans; and, lastly, because my companion, Mr. Trevor-Battye, on whom I had relied to tell you more about the scenery, which his photographs so well illustrate, is, owing to illness, unable to be present.

Nepal is unique in this respect, that it remains, a solitary instance in the world, of a friendly country which, from political reasons alone, is inaccessible to Europeans. For, though during nearly a century our relations with its rulers have been perfectly peaceful, and latterly even cordial, and though the present ruler of Nepal is a man of European culture, speaking perfect English, and understanding English customs, politics and civilisation in a way that few Oriental rulers do, he has rigidly adhered to the policy instituted sixty years ago by the all-powerful minister, Jung Bahadur, and has maintained a system of government which may be best described as a paternal despotism founded on the religion and customs of his people. It is, therefore, impossible for Europeans even to enter Nepal unless specially invited, as we were, by the British Resident at Katmandu, Colonel Manners-Smith, V.C., or by the Maharaja Sir Chandra Shamsher Jung, G.C.B., G.C.S.I., G.C.V.O., to both of whom our most cordial thanks are due for their hospitality and kindness during our too short stay there.

Though our relations with the Nepalese Government were not at first so uniformly friendly as they have been ever since the Indian Mutiny, when Jung Bahadur came to our assistance with his army, yet we have learned that it is possible to do what has never been done by any other European Government—to live as neighbours on a frontier of over five hundred miles without any friction with an Oriental nation distinguished for the bravery and patriotism of its people. And after comparing the conditions which exist in the kingdom of to-day with the state of some parts of Bengal in recent times, I think that we can learn much from the Nepalese in the art of governing primitive mountain races. I will refer those who wish to know more of the country to Sir W. W. Hunter's "Life of Brian Hodgson" (1896), who resided in Nepal as British Resident for many years, and who was the first to make known to science a great number of its animals and birds; or to the "Imperial Gazetteer of India," Vol. XIX. (1908), where an excellent account of the country will be found. Hodgson went to Nepal as a young man in 1820, as clerk to the Resident, and only remained two years; but as his health broke down in Calcutta he returned in 1824, and in 1825 was made Assistant Resident, a post which he filled until 1833. During this time he studied the people, languages, products, and trade of the country as no one has done since; and when Sir Herbert Maddock, his chief, retired in 1833 he succeeded him as Resident. The internal feuds which went on at this time made his position a very difficult and, at one time, a dangerous one; for during a mutiny of the native troops which took place in 1840 a plot was formed to attack and destroy the Residency with its guard and inmates. But Hodgson, as brave as he was diplomatic, succeeded in holding his own during the trying period of the Afghan War, and might have remained in Nepal for many years if he could have got on with Lord Ellenborough. But in 1843 Hodgson, unable to bear any longer the treatment of that autocratic Governor-General, retired, to the great grief of the Raja and people. He then went to Darjeeling, where he lived until 1858, and spent the time entirely in scientific work relating to the languages, religions, ethnology and zoology of Nepal and Tibet, which for quality and quantity has hardly been equalled by any other member of the Indian Civil Service. He then returned to England, where he lived until 1894, in the enjoyment of the numerous honours and friendships he had won, and presented his large collections of manuscripts, natural history specimens, and drawings to the nation.

We arrived at Gorakhpur, in the United Provinces, on February 6th, and met Colonel Manners-Smith, who had kindly invited us to join him in camp at Bikna Thori, on the Nepal frontier, to see a kheddah which had been arranged to take place near the locality

where King George had such grand tiger-shooting when he was in India for his coronation. We arrived at the frontier by rail, and rode up to a camp in the low outer range of hills which enclose a flat, and in some places marshy valley, a little higher than the Terai. The usual system of catching elephants in Nepal differs from that adopted in other parts of India which I am about to describe, and is much more dangerous both to the pursuers and the pursued. It consists of driving the wild elephants into a valley where they can be surrounded, and then, after separating those which it is intended to catch from the herd, overpowering them by special fighting elephants and tying them up separately. In these fights many of the elephants are injured, and fatal accidents to the men employed are not uncommon. But on this occasion the Nepalese Government had determined to try the system of kheddahs usually adopted in Assam and Southern India by the Indian Government, and had obtained the services of Mr. Armstrong, of the Bengal Police, and of some of the skilled elephant-catchers formerly employed by the Government Kheddah Department at Dacca, which has now been disbanded. This valley and the hills surrounding it are of much the same character as the Dehra Dun, and are covered on the dryer land with forest, mainly composed of sal and other trees, often of much larger dimensions than those in the Dehra Dun or in the Sikkim Terai, and in the open and more marshy parts by a heavy grass jungle, which forms a sanctuary for wild elephants, tigers, rhinoceroses, and other game which are preserved for use and sport. At this season the country is dry, cool and healthy, but in the rainy season very hot and malarious. The next day we rode on to the large camp which had been formed for the men employed in the elephant-catching operations on the banks of a river, and found that a considerable number of wild elephants had already been surrounded in a piece of forest about four miles in circumference, bounded on the south by the outer range of hills, on the west by a river whose bed was now partly dry and open, and partly covered by grass and reeds high enough to conceal elephants. The force employed to effect this surrounding consisted of two regiments of Nepalese soldiers directed by the General-in-Chief of the Nepalese army. After the wild elephants, about thirty in number, had been surrounded, a line of guards was immediately stationed at posts fifteen to twenty yards apart all round the forest. At each of these posts three soldiers were on guard, who built themselves grass huts, and kept fires burning all night to keep the wild elephants from breaking out. Our camp was on the low banks of a river overlooking the scene of operations and close behind the guard-line. The first thing to do was to select a position for and build a stockade into which the elephants could be driven, and in this matter the old Jemadar from Dacca, a veteran of seventy years who had spent his life in this work, was the best adviser. He insisted in going alone on foot into the ring where tigers and rhinoceroses were known to be at large with the wild herd, in order to choose the most suitable place. For long experience has shown that wild elephants cannot be driven like cattle, and it became evident, from the frequent attempts which they made at night to break out in a particular direction, where was the best place to build the stockade. This took three days of hard work, as a large number of strong posts fifteen feet long by eight to ten inches in diameter had to be fixed in the ground and supported by struts and cross-bars strong enough to resist the pressure of the herd when driven in. The stockade was a circular space fifty feet across, with a falling gate on one side, suspended by ropes which were cut to let it drop. From the entrance a narrow lane of strong posts extended for two hundred yards, gradually widening into two wings, which opened out like a funnel, and were extended by a line of cloths hung on poles, to form a lead into the mouth of the alley. The walls of the stockade and the lane leading to it were covered by grass and branches so that the elephants might not suspect danger too soon. During the four nights that we were in camp waiting for the stockade to be built, there were constant alarms at various points on the line, as the wild herd, after drinking in the river—where we could often see their backs and hear their trumpeting and screams from our tents—made efforts to find a weak spot in the guard line. On the second night a wild tusker, supposed to be a rogue, broke into the surrounded area from the outside, and made the enclosed herd very uneasy. This tusker was very bold, and one night, just after dinner, he came down and stood within twenty yards of the fires where a crowd of excited men were yelling and firing blank charges in his face, and we quite expected that he would attack and break out. But though we saw him quite close in the moonlight, he eventually retired and the camp

became quiet again. On February 12th, after several alarms in the course of the night, which must have been a trying and anxious one for the guards, who had now been for four consecutive days on duty, Mr. Armstrong announced that all was ready, and that about eleven o'clock, when the elephants were generally quietest, the drive would take place. Two platforms had been erected above the stockade into which we climbed, and the driving-party, under the command of Armstrong and the old Jemadar, were mustered. The Nepalese were selected from the most experienced jungle-men, and between every two of them one of the Dacca men accustomed to this work was placed. Absolute silence was ordered at the stockade when the party marched off in two lines, which spread out from the stockade and swept the whole of the forest within the guard-line, and when the leaders met on the far side, perhaps a mile away from the stockade, gradually closed in towards it. After waiting an hour or so we heard a great noise accompanied by many shots from the guard-line, which told us that the elephants were on the move, and the noise came nearer and nearer till we thought that the herd must be within the wings of the stockade; but after a time the noise died down, and for an hour nothing more was heard. The same thing happened again, and at last Armstrong came back to the stockade, very hot from his exertions, and told us that the Nepalese drivers were so excited and keen that he could not keep them in order, and that on the first occasion the elephants were on the point of entering the wings but were so frightened by the noise that they broke back. After a consultation it was decided, on the advice of the Jemadar, to remove the cloth screens to another position where the grass was thicker and wait a bit before trying another drive. This was done, and about 5 P.M. a final and successful effort was made. The elephants came on within the screens, and then Armstrong and his men lit grass fires behind them, and by dint of firing and yelling got them on the move towards the alley, into which an old cow first came rushing down. The others followed her, and as soon as they were all within the wider part of the alley the crowd of men yelling and firing rushed them forward in a long line. We could only see their backs as they came down the alley one after another and entered the stockade with a rush. The rope which held up the gate was cut a little too soon, shutting out one or two of the hindmost elephants, but these were determined to follow their companions and forced their way through the gate, which was so hung as to push inwards. The whole herd was then inside, and until it was dark they continued to go round and round in a dense crowd, whilst the men who surrounded the stockade prodded their trunks with spears or fired blank cartridges in their faces when any of the larger ones tried to force their way through. It was very curious to see the way in which the youngest elephants, of which there were three only a few months old, managed to save themselves from being trodden down, by keeping between their mothers' forelegs, and the care which their dams took to protect them. As it was then too late to begin to tie up the animals, we left the stockade at dark to the care of the guards who had now left their posts and come to the stockade. Next morning we returned to see the process of roping and leading out the elephants; but though several of the finest and strongest tuskers were brought into the enclosure the mahouts seemed unused to the work they now had to do in such a dense crowd of elephants. There was not room enough for the noosers to go in on foot, and the constant movement of the crowd surging round and round made it very difficult to get nooses on their feet from the outside. This work requires experience which the Nepalese had not previously had, and from the pictures I will show you, which were taken at a kheddah in Southern India where they have more experience in noosing in a stockade, it seems that they are there more adept in what seems a most dangerous work. But though the mahouts had spears with which to prick the trunks of any wild ones which might attempt to touch them, I never saw one offer to do so. Many of the captured elephants now seemed very tired and thirsty—as well they might be after such days and nights as they had endured—and we never thought that the young ones would have survived; but though it took three days before the whole thirty-three elephants were finally tied up and pulled out of the enclosure, not one was seriously hurt, though several of the oldest were released as not being worth the trouble of training. I will not occupy your time any longer with an account of this process, which has been well described by Sanderson and others. But though native mahouts, who have spent their lives among elephants and have inherited from their fathers a knowledge of their management in health and in sickness which few, if any,

Europeans have ever acquired, I believe that a lover of animals who would pay the same attention to elephants that many Englishmen do to horses would learn a great deal which would be valuable in managing the elephants which are still indispensable in the forests of India, and might be even more useful in some parts of Africa.

Ten days later we arrived at Raxaul, a frontier station a little to the east of Bikna Thori, where the Resident has a bungalow, and where he had made arrangements for our journey to Katmandu. The first stage of thirty miles through the level plain of the Terai we made in doolies carried by bearers, and at daylight we found ourselves in the Sal forest near Churia where the outer range of hills begins. Here we breakfasted and went on horseback over a low rocky sandstone range in which *Pinus longifolia* is a noticeable but not important tree; and passing through a narrow gorge, where in many places the dry river-bed is the only road, sometimes impassable in the rainy season, we crossed an open valley where the cotton trees, *Bombax malabricum*, were of great size. The one of which I show an illustration was 120 feet high by 30 in girth at five feet from the ground, and about 60 feet round the buttresses at ground level.

We then followed the banks of a river along a road practicable for bullock-carts and wooded with tropical trees, but not nearly so luxuriant or so varied in its vegetation as a valley in Sikkim of similar elevation would have been. The large white blooms of a shrubby climber called *Beaumontia* were at this season the only striking flowers I saw, and along the road there were but few birds to be seen, as numbers of bullock-carts were constantly passing. In the evening we reached Bhimphedi, a large village at the foot of a steep range of mountains over which the path is quite impracticable except for coolies; and here we were met by a party of men with doolies and torches, who surpassed all the bearers I have ever seen in their power. For to carry a man of my weight in the dark up a winding path on a gradient of thirty to forty-five degrees and covered with rolling stones was a work I should hardly have thought possible till I experienced it; and they only stopped for a few moments to relieve each other on an ascent of over 2,000 feet. Near the top of this mountain, the Resident has another bungalow at Sisagarhi, between five and six thousand feet above the sea, where we found dinner and beds ready. Next morning we had a fine view over the outer hills, and found rhododendrons in flower and evergreen oaks all around us on the dry grassy hillsides, reminding me far more of Chakrata in the North-West Himalaya than of anything in Sikkim. Next morning we went on with the same doolies, and after crossing the ridge at about 7,000 feet descended on foot by a very steep rocky path through a fairly thick forest on the north side, where, though some orchids appeared on the trees and climbing plants and ferns were numerous, the whole aspect of the vegetation was utterly unlike the much damper forest at similar elevations in Sikkim. At the foot of this mountain we found ponies kindly sent by the Maharaja, and turned north-west up an open dry valley, cultivated in places with wheat and mustard as winter crops in small terraced and irrigated fields, and passed over bare grassy downs on which a plantation of *Pinus excelsa* had been made. The villagers' houses were built of brick and roofed with tiles, mostly two-storied, the upper floor being inhabited by the people, and the lower used for cattle and stores. A small primrose, *Primula Munroei*, a Polygonum like *P. vaccinifolium*, and a small stemless *Tragopogon* were the first signs of spring. Crowds of Hindu pilgrims on their way from the plains of India to a religious festival at Katmandu were on the road, nearly all walking, but a few riding or carried on coolies' backs. Among them were large numbers of women, who caused my companion, new to India, to remark that this was the only country he had ever seen where it was possible to pass thousands of women without a smile on the face of one of them. The contrast between their resigned and melancholy expression and the smiling faces of the Nepalese women, who crowd the bazaar and as porters welcome the stranger on his arrival at Darjeeling, is very striking. In the afternoon we ascended another steep ridge through forest mainly of evergreen oak, and at the top had our first view of the great open valley of Katmandu with the snowy mountains in the background. The great open valley terraced and cultivated wherever possible, with the city of Katmandu in the middle of it, and bare mountains covered with brown grass and scrub on the south exposure, formed a scene which, though beautiful in itself, was so unlike and so very inferior in grandeur to the scenery of Sikkim that I could hardly believe I was only two hundred miles to the west of that enchanting country.

Pilgrims, and coolies carrying immense

burdens of ironware and European goods on the way to the valley, crowded the path; whilst those returning were mostly laden with coarse dirty wool from the interior. The last descent was so steep and difficult that a horse-dealer bringing horses from Kabul had some trouble in getting them down. At the bottom we found a good road and a well-appointed pair-horse carriage waiting to take us to the Residency, where we were hospitably received by Colonel Manners-Smith.

It is difficult, if not impossible, for anyone who does not speak fluently the language of a country he visits, and who has no opportunity of conversing freely with the people in their own language, to form a correct opinion of the economic or social condition of its inhabitants, especially when restricted to a very small area surrounding the capital. But after many years of travel in Asiatic countries, including Asia Minor, Siberia, Japan, Formosa, China, Java, the Malay Peninsula, and with an intimate knowledge of Sikkim and other parts of India dating back to 1870, I formed the opinion that the Government of Nepal is a form of government well suited to the ideas of Oriental peoples. Though the rulers of Nepal have rigidly kept their country free from European education and commerce, and have strictly adhered to the tenets of their own religion and customs, yet the facts that the people appear healthy, happy, and not over-taxed, that the standing army is one of which any Oriental State may be proud, and that law and order prevail to an extent which has kept the relations of their people and ours peaceable and friendly for a very long period, prove that such a form of government has advantages which modern reformers cannot overlook. And when the internal condition of Nepal is compared with what it was in Brian Hodgson's time, when bloody quarrels amongst the ruling chiefs and members of the Royal Family were common, one must admit that for a country where the land suitable for cultivation is insufficient for the maintenance of an increasing population, and where the natural products offer few openings for trade or manufactures, Nepal is in many respects fortunate. I cannot help remarking the difference which exists in the friendly relations between British officers, soldiers and tea-planters, and their Nepalese soldiers, comrades, and labourers, with the attitude and comparative want of sympathy between Europeans and most other natives of India. One cannot work long with Nepalese without acquiring a respect and liking for their pluck, endurance and cheery goodwill under conditions of danger and hardship; or ignore the devotion they show to Englishmen who treat them properly and understand their ways. As pioneers on the North-East frontier of India they have no rivals, and though there is much difference between the various castes and tribes, yet, on the average, I prefer them to any other natives of India with whom I have had to do. The fact that we are able to recruit and maintain no less than twenty battalions of the best native infantry in India entirely drawn from Nepal, and that the labourers employed in the large and important tea industry of British Sikkim have been almost entirely supplied by Nepalese immigration, proves the importance to British India of our friendly relations with Nepal.

The Maharaja has done much to improve the native breeds of cattle, and has imported from India and Europe bulls of various breeds with this object. He is also trying to improve the sheep with rams from my own flock. The native sheep are a large coarse-woolled breed, similar to those kept by the Nepalese on the frontier of Sikkim and commonly brought to Darjeeling for mutton, and are able to endure the cold and wet climate of the higher ranges better than the improved breeds in England would probably do; but below, about 6,000 or 7,000 feet, it is not a country generally suited to sheep, though goats are numerous.

Buffaloes are kept in large numbers in the Terai, and are valued for their milk and meat, but do not seem to be used for agriculture as much as in Formosa, where on steep hillsides, lying with a slope of twenty to forty degrees, narrow irrigated terraces are ploughed by buffaloes, which are much more active and better climbers than their normal habitat would lead one to suppose.

In Nepal, as in Sikkim, most of the cultivation is done by hand labour, and irrigation is general wherever water can be brought. In the dry weather it was impossible to judge of the crops, but the rice and maize stubble did not indicate such good soil as in Sikkim; and I believe that the area of land available for cultivation at healthy elevations is in most parts of the country too small to allow much increase in the population, who emigrate in increasing numbers to Sikkim and the frontier districts of Assam.

Both sexes from their childhood acquire the habit of carrying very heavy loads on their

backs, especially the tribes of the higher levels, who carry on nearly all the trade between Nepal and Tibet in loads of from 80 to 200 lbs. over paths that would be impassable to beasts of burden.

The forests of Nepal do not seem to have received from the Government anything like the attention they deserve, as the growing scarcity of timber in Bengal and the United Provinces must make them valuable in future if they were properly protected. A partial survey has recently been made by a native officer, lent by the Indian Forest Department, but I could not hear that anything had as yet been done to bring them under systematic management. Neither tea nor camphor, both of which would no doubt grow as well as they do in Sikkim, are grown, though I believe that camphor might become a valuable and profitable product.

Whether the necessity for increased revenue to pay for the many kinds of European goods which the Government and upper classes are requiring in larger quantities, will eventually induce the Government to pay more attention to trade and industry than they have done at present is a problem that time alone can solve; but up till now no permission has been given to any foreigners to embark on such enterprise —Nepal for the Nepalese being the fixed policy of the past and present rulers.

Of the natural history of Nepal I can say little from personal observation, because we were not able to visit the mountains of the interior, where are found a great variety of birds and animals which have been described many years ago by Hodgson, who, during his long residence, employed native collectors to procure, and native artists to draw, all that he could get. In this way most of the rarer animals which inhabit the central Himalaya were first made known to science, but of their distribution little is known. There are a number of genera represented in the north-west Himalaya by species different from those which are found in Sikkim and Bhutan, and it would be very interesting to know where these species meet, and whether they overlap and interbreed. But the mountains nearest to the valley, where alone the Resident and his friends are allowed to go, are too low, and so little virgin forest remains, that their fauna and flora are much poorer than those of Kumaon, Garwhal and Sikkim. In the Maharaja's grounds at Katmandu we saw three living deer which had been caught on the frontier of Tibet and of which little is known to Europeans. One I believe to be a female of the species known as *Cervus Wallichii*, of which a fine male, now in the Zoological Gardens, was presented by the Maharaja to King George when in India four years ago. Another is a male of *Cervus affinis*, which inhabits the high forest-country in the north-west of Bhutan, and whose antlers are sometimes brought by natives to Darjeeling, where it is known as the Shou. The third is *Cervus Thoroldi* = *C. albirostris*, discovered by Dr. Thorold in the country north-east of Lhasa and not known to be a native of Nepal.

In the Maharaja's palace, which is a large modern building in European style, I specially admired the very delicate carving which is done by native carvers in a wood known as Dar. *Böhmeria regulosa*, Wall.; this is a very close-grained red wood, easy to work, and found along the lower hills, but not usually attaining a large size. The immense quantity of fine woodcarving, with which the older houses of Katmandu are adorned, shows the talent of the Newars in this branch of art, which, however, seems to be a dying if not a dead industry, as there are now no professional carvers except those employed by the Maharaja, and no shops where such beautiful work can be procured. The same seems to be true of the workers in copper, brass and silver, who now work only to order, and I cannot help thinking that these arts might be encouraged by making an outlet for their work in British India, where there is now a good demand amongst tourists and residents for the fine metalwork brought from Lhasa, much of which is similar in character to that of Nepal.

To most travellers the buildings, temples and ancient monuments of the towns of Katmandu and Bhatgaon are probably the greatest attraction in Nepal, as their architecture is unique. The photographs which I show will give you a better idea of their character than any words of mine.

A Note on the Photographs of Scenes in the Cities of Nepal.

By Aubyn Trevor-Battye, M.A., F.L.S., etc.

A point that will at once be noticed in these pictures is this: that many of the faces of the streets are clearly not those of the inhabitants of the country; the high cheek-bones, the narrow eyes, the short square build, the general "Mongolian" type associated with the idea of the Gurkha are wanting. These are men

from the plains of India on one of their great pilgrimages to Katmandu. There were many thousands of these pilgrims. For the naturalist, accustomed to search for the origins and causes of periodic movements, such human migrations, and on so large a scale, must needs have an interest. We must remember that although at the present day Buddhism and Brahmanism both obtain in Nepal, where the two are indeed inextricably confused, it was not always so. When the Buddha made his first converts in the Himalayas, five hundred years or so before the Christian Era, he found Brahmanism the established religion of Nepal. Therefore, just as birds, under the memory of the species for a once warm home, go northward with the spring into Arctic lands, so these poor Hindus move northward to a home of the infancy of their faith.

I have seen many pilgrimages—pilgrims from the farthest confines of the Roman Church drawn to Lourdes for healing; pilgrims on their way to Mecca; Russians from Siberian wastes come down to the Jordan for the dipping of the shrouds that will enwrap them when they die; Hindus from far Ceylon bathing in the sacred river at Benares—but this pilgrimage in Nepal was certainly in some way the most remarkable. The difficulties of the road will be evident from the photographs. Of those thousands of struggling men and women many were infirm and aged, some so worn by the hardships of the weary way that they would probably not live to see their homes again; a few who had money to spare for this advantage were huddled up in baskets on porters' backs.

The Gurkha, as far as Nepal goes, only dates from the eighteenth century. We are here concerned with the Newar, the original inheritant of the country. The Newar is Tibetan, as the Gurkha is supposed to be Rajput, in origin. His are the arts, the industries, the agriculture. All, then, that we see here in these pictures—architecture, woodcarving, metal work, stone—is Newar in conception and workmanship. And although the pagoda in principle is Chinese, its detail is so entirely different from that which we are accustomed to see in works on China, its decoration is so vigorous, so unconventional, and so true to life, that Nepal may be said to have a distinct art of its own, and that art expressed by great artists.

The Newar is primarily an artist in wood, and his control over that medium is astonishing. The decorative forms of windows, doors or plinths are not confined to shrines or to houses of the well-to-do; it is a principle throughout the land, some of the poorest country cottages having most beautiful workmanship. The picture of a wayside cottage shows the same form of horseshoe-headed window, with its lattice, that we later find elaborated in the wonderful buildings of the town. For although geometrical design forms the basis of this work, it is not "left at that," as in the lattice screens of India and Burma, but, where the money was sufficient, is overlaid by a complicated tracery of foliage, flowers or animal subjects. These are not only in their main lines true to Nature, and therefore quite recognisable (notice the mango over the doorway), but are arranged in a well-defined scheme of composition in the most artistic way. The ability to portray well-known animals is common even to primitive people; the reindeer of the Cave-men are real reindeer, the antelopes of the Bushmen are unmistakably Oryx or Sable, as the case may be. But these people, each in their day, were the *children* of the world, and their drawings, like all drawings done by children, insisted on detail as the child's eye sees it.

The Newar artist had advanced a long step farther; he was no nursery artist—he had "arrived." He knew exactly how to generalise, how to insist on the big features that gave his plant or his animal its recognisable character and individuality, and how to drop all those details that did not tell. And this was equally true whether he worked in wood or in metal; less so, perhaps, in stone. For all that, when form demanded it, he could be as strictly conventional as a Greek. As examples of this, notice the conventional lotus on the well-head and on the capitals of the monumental columns.

Two types of temple are noticeable in these pictures—the Chaitya type and the Pagoda type. The first is the Buddhist form, the other is Nepalese Hindu. These latter are not found, I believe, in India, if we except one that stands out unmistakably among the temples of Benares—the pious gift of a Maharaja of Nepal. It will be noticed that each story of these pagoda temples is supported by long wooden struts. Recourse to such a device to support an overhanging plinth or other structure is elsewhere common enough; a familiar instance is that of the Ponte Vecchio. But the Newar has gone one better than the Tuscan, for he has carved each strut elaborately from end to end.

The shrines would take a paper to themselves. Two, I think, are shown to-night. They are of wood, metal, and stone. In noticing their

extraordinary wealth of decoration, it is necessary to realise that nothing is introduced without a meaning; that each detail, decorative as is its effect, has a distinct and definite significance in the religious sequence of a people's worship.

The doorway of the Durbar Hall in Bhatgaon is, of course, well known as one of the greatest achievements in metal in the world. It is of copper overlaid with gold. It is, indeed, a thing of fascination; the folds of its serpent seem to writhe, the lizard on its lintel might be darting in the heat.

But of all the remarkable and beautiful features of the streets of these Nepalese cities, nothing holds the attention so strongly as the monumental statues. I do not know whether these are absolutely peculiar to Nepal, or whether they are also met with in Tibet; the writer, at least, had never seen anything like them. They are sculptured portraits of various rulers who built the temple in front of which they stand. First there is a simple base, then a square stone pillar, perhaps 30 to 50 feet high, then a beautiful capital of lotus pattern. On this is placed sometimes a throne of copper gilt, based on animals—elephants or others. On the throne the Newar king is seated, with the cobra or a gilt umbrella as a canopy above him. In some examples his family are about him; in others he sits upon no throne, but kneels in an attitude of adoration before the temple of his gods. No description could adequately convey an idea of the extreme and beautiful dignity of these monuments. What they owe to their surroundings it is impossible to say; they belong to Nepal and not to Trafalgar Square. There are, at any rate on the Maidan of Katmandu, some very fair equestrian figures of Maharajas that are of Western making; and to come upon these after the others was to change the sublime for the commonplace. Seen where they were, these columns of the rulers seemed structurally, decoratively, spiritually, and in their beautiful repose, a final word in art.

DISCUSSION.

Sir Louis William Dane, G.C.I.E., C.S.I., in opening the discussion, said he had been delighted to hear the very high opinion the author had formed of the Prime Minister of Nepal, His Excellency the Maharaja Sir Chandra Shamsher Jung. He thoroughly endorsed all that had been said as to the extreme desirability of maintaining the present cordial relations between Nepal and India. An inspection of the map showed that Nepal lay right on the flank of the main chain of communications between Calcutta and the North-West frontier, and if by any chance the State of Nepal at any future time did not show its present friendly attitude towards India things would be very awkward indeed It was quite true that, on the whole, this country had been friendly with Nepal since the beginning of the past century, but the present very friendly relations were largely due to Lord Curzon, and to the very distinguished statesman who was now the *de facto* ruler of Nepal. Things at one time had drifted into rather an awkward situation owing to the extraordinary dread the Nepalese had of China. In the last century China succeeded in invading Nepal, and the Nepalese were very much alarmed at the idea of a future invasion by China. They were disposed to think at one time that China was quite as big and powerful a country as Great Britain or India; but he was glad to notice after Sir Chandra Shamsher Jung saw Lord Curzon in 1903, when he (the speaker) had the pleasure of making his acquaintance, his ideas on this subject were entirely changed, if he ever had such ideas; and from that time to the present he had most loyally and strongly supported India, and had been a most faithful and true ally of the British Government.

Sir H Evan M. James, K.C.I.E , C.S.I., said that, having had the advantage of visiting Nepal, he quite admitted the beauty of the woodcarvings in that country which had been described by the author, but he thought it was a mistake to praise them at the expense of the other woodcarvings of India. He did not agree that the woodcarvings of Nepal or its art generally were superior, or indeed equal, to those of Ahmadabad, or other places in Gujarat, or even the Deccan. A good deal of Chinese influence was noticeable in the pagoda-like temples, but a great many of the remaining features were to be found in other parts of India. For instance, in the south of Orissa there were several beautiful pillars to be found, which might almost have been a copy of the tall pillar shown in one of the photographs, with the great Garuda, the famous bird of Vishnu, on the top of it. It was not at all uncommon when a traveller saw a rather unknown country to admire it extremely, but personally he did not think that either the house or the temple architecture of Nepal was better than in the provinces which he had named. He was anxious to speak up for old friends as well as for new.

Mr. R. A. Leslie Moore said he simply desired to ask two questions. The author had stated that the Gurkhas were descended from Rajputs. He did not contradict that statement for a moment, but he would like to know how it was that they were so different in stature and in appearance from the Rajputs. The Gurkhas had Mongolian features and the Rajputs had not. His second question had reference to the statement made by the author that when he went through the city of Katmandu

he was accompanied by two or three guides, or rather guards. Was it the case that Europeans were so objectionable in the city of Katmandu that they could not go about without guards?

Mr. Elwes, in reply, said that the criticisms that had been made by Sir Evan James were directed to the statements that had been made by Mr. Trevor-Battye, and not those made by himself. Personally, he thought that Mr. Trevor-Battye, not knowing the woodcarving and architecture of other parts of India as well as Sir Evan James, had slightly exaggerated the peculiarity and beauty of the Nepal woodcarving and architecture. He knew that was the case because he had seen similar things in Kashmir and other places; but, taken as a whole, everyone must admit that Katmandu was unique. The statements to which Mr. Moore had referred were also made by Mr. Trevor-Battye and not by himself, and he entirely declined to take responsibility for them. Whatever was the origin of the Gurkhas, he thought their stature and their character also had been enormously changed by their mountain habitat. He agreed that the Gurkhas had Mongolian features, and had definitely stated that some of the tribes with whom he was acquainted were very Mongolian indeed. He was not sure that many of the Buddhist tribes were not in most cases pure emigrants from Tibet. The best camp cook he ever had was a Jurga—a Nepalese. He was a pure Buddhist, and said his prayers like a Llama every morning before he brought him his breakfast. The mixture of the tribes was very considerable. He thought Mr. Moore had rather misunderstood what he meant to say with regard to his guides or guards in Katmandu. He and his friends were visitors of the Resident; they had two or three Nepalese chuprassees, and a whole crowd of people following them about, and under those circumstances they did not have the same facilities for observation, for sketching or photographing, as they would have done in a place where they could walk about as they pleased.

Mr. G. W. Christison said he intervened with reluctance even for a few seconds at this prolonged stage of the proceedings. Having had long experience of the Nepalese military castes in working Darjeeling gardens, it would be disloyal not to express entire agreement with all that Mr. Elwes had said in praise of the Gurkha. With tactful, judicious, sympathetic treatment they were adaptable and became very competent, though the planters, owing to methods too common, unfortunately, had not always made the most of them, in their own interest or that of the proprietors. He was glad to bear testimony to the more intelligent men amongst them having for twenty-five and thirty-five years given service as conscientious as mortal man could render. On this account he would remember such men as friends as long as he lived. He rose to allude to deforestation, a matter of vital importance, especially in such a mountainous country, where the damage done was often at a great distance from its cause. The subject was a wide one, and he made no attempt to deal with it. Darjeeling, the adjacent hill district referred to, had been seriously injured by deforestation within its own borders, and it, as well as the country below, had also suffered from the shameful destruction of forest throughout Sikkim some years ago, for which, unfortunately, the Government of India was mainly responsible. On the Bhutan Hills, on the east, deforestation was also reported to have caused damage in the district below. He had only had a distant look at small portions of Nepal from points on its eastern boundary, from time to time, during the last fifty-one years. In reference to the south-eastern corner of those hills above the Terai, the slopes were denuded of all forest and even brushwood, and of late years were badly scarred by landslips. Though this was the characteristic of Nepal generally, owing to situation, it was not so harmful to Darjeeling district as Sikkim, but it must do some damage to the plains below. For years he did his utmost to induce the Government to take measures to remedy the evil. Five inspections and reports were called for from Forest Department officers, three of which, by Mr. Grieve, were able and illuminating. An Act was also drafted but never passed, and he believed no remedial steps had yet been taken. Planting was costly, requiring care afterwards. The only practical remedy was inexpensive, because providential. It was wonderful how landslips and most of the dangerous zones, if simply left alone, became clothed with protective scrub, and even trees of a kind, unaided by man. All that was required was inexpensive fencing to prevent trespass of cattle and goats. The loss of profitably productive soil was rarely necessary to give security. He wished Mr. Elwes—than whom no one living was competent to give more valuable testimony—would kindly inform the meeting on two points: did he consider deforestation existed to the same serious extent throughout Nepal as in Sikkim and Darjeeling; and how did the present condition of deforestation throughout Darjeeling hill district and Sikkim compare with what he observed during his first visit to those parts many years ago?

Mr. Elwes, in reply, said that to go into the question of the afforestation of Nepal or Sikkim would take much more time than he had at his disposal, and he was not prepared to do so at the moment. He could, however, absolutely confirm what Mr. Christison had said as to the vast, ruinous, and, he would go as far as to say, disgraceful destruction of invaluable virgin forest that had taken place both in Sikkim and in Nepal since he first knew the country. It so happened that the Nepalese forests through which he passed were very much better preserved, partly for the purposes of game, than the Indian forests, and there had been no devastation of the outer hills in Nepal, such as

there had been in some parts of Sikkim. But in the interior, where the land lay at a higher altitude, he believed the devastation in Nepal had been even worse than it had been in Sikkim. Those, however, were matters on which there would always be differences of opinion, and it was much too large a subject to deal with that afternoon.

Sir Steyning William Edgerley, K.C.V.O., C.I.E. (Chairman of the Indian Section Committee), in proposing a hearty vote of thanks to the author for his instructive and interesting paper, said that in December, 1914, this country had hoped fittingly to celebrate the existence for a century of "a scrap of paper" embodying a treaty which was made between America and England. In March of next year they might equally celebrate with Nepal the existence for a century of another "scrap of paper," the Treaty of Segauli, which had remained in force from March, 1816, up to the present time, and which he trusted would still remain for many years to come. It was possibly a great advantage to the Nepalese that the treaty was not made with the Germans.

Mr. Elwes inquired whether it was not unique in history that a treaty between an Oriental and a European country should remain absolutely unbroken for a century. Was it not at the same time highly creditable to the rule of Nepal that such a thing had happened?

Sir Steyning Edgerley replied that Sir Louis Dane was more competent than he was to deal with that question, but, speaking on the spur of the moment, he thought he could remember at least two other treaties settling our relations with Indian States which had existed practically as long as the Treaty of Segauli.

Sir Mancherjee M. Bhownaggree, K.C.I.E., in seconding the motion, said the paper had been of surpassing interest, as it dealt with a country about which so little was known. At the present time everybody was curious to learn more about it, as it was the home of that brave soldier the Gurkha, who was now taking his share, as a subject of the King-Emperor, side by side with his British comrades in defending the public law. One of the points he noted with great satisfaction was the tribute the author paid to the characteristics of the people of Nepal. Mr. Elwes had stated that there was a sort, if not of kinship, at least of affinity between the natives of Nepal and British people. That showed that the author had approached the subject in a very sympathetic spirit, and for that as well as for his very interesting and instructive paper he was entitled to their very best thanks.

The resolution of thanks having been put and carried unanimously, the meeting terminated.

Mr. Trevor-Battye communicates the following note in reference to the remarks on his paper made in the course of the discussion:—I am sorry if I seemed to claim more knowledge of Nepalese art than I really possess; this is little enough. Nor have I travelled in the Deccan, nor seen the cities south of Orissa. I did pay considerable attention to architecture—structural and decorative—in Gujarat, and particularly to that in the city of Ahmadabad. Whether the extremely interesting work of this city is more or less beautiful than that to be seen in the cities of Nepal is after all a question of personal feeling; I find it difficult to compare the two, for, as I am sure Sir Evan James would agree, they are more remarkable in their differences than in their resemblances. I am afraid I cannot help with Mr. Moore's question. If the Gurkhas were from Rajputana, as they are said to claim, it certainly would seem strange that they have so greatly lost that type. [We had Gurkhas at the kheddah who were not at all Mongolian in feature.] But if under the Mohammedan advance they severed to a great extent their connection with India, favouring rather relationship with Tibet, intermarriage might bring about the change? Probably the population of Nepal is now of a very mixed character, and the Mongolian type seems to be more or less common to all the mountain folk.

NINTH ORDINARY MEETING.

Wednesday, February 10th, 1915; Carmichael Thomas, Chairman of the *Graphic* and *Daily Graphic*, in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Dubash, Peshoton S. G., 135, Highbury New Park, N.; and care of Pestonji Bhicaji, Kimari, Karachi, India.

Lowton-Brain, L., Director of Agriculture, Kwala Lumpur, Selangor, Federated Malay States.

Mason, Charles Thomas, Sumter Electrical Company, Sumter, South Carolina, U.S.A.

Murfee, Professor Edward Hunter, A.M., LL.D., Brenau College, Gainesville, Georgia, U.S.A.

Vaishya, Ramjidas, Sweet Cottage, Gwalior, Central India.

Van Deventer, Harry R., Sumter Electrical Company, Sumter, South Carolina, U.S.A.

The following candidates were balloted for and duly elected Fellows of the Society:—

Dean, Oliver H., A.B., LL.B., 116, East 36th-street, Kansas City, Missouri, U.S.A.

Parris, Hamilton Harcourt, The Croft, Grenville, Grenada, British West Indies.

Taylor, H. Blake, 22, Cromwell-crescent, S.W.

THE CHAIRMAN, in opening the meeting, announced that the author was, unfortunately, ill and unable to attend the meeting, and the paper would, in his absence, be read by the Secretary of the Society, Sir Henry Trueman Wood.

The paper read was—

BRITISH LITHOGRAPHY IN 1915.

By F. VINCENT BROOKS,
Member of the Senefelder Club.

We live in a time when many things are in the melting-pot, when many changes are advocated by many different authorities.

Most of us are divided into two classes—those who, even if, like myself, they are no longer young, yet have an ear attuned to the least whisper that breathes the language of the arts and crafts that they love, and those who stand four-square opposed to every form of innovation. Lithography, like its sister arts, has its advocates of new developments, its defenders of old methods, and to one or other class must of necessity belong our chief modern workers—Mr. Joseph Pennell, Mr. Frank Brangwyn and Mr. Spencer Pryse, Mr. Ernest Jackson, teacher as well as artist, and therefore more capable of understanding the difficulties of our craft, and many others, my colleagues of the Senefelder Club.

This may not be a favourable opportunity to speak of the personal side of the question, for we have been sorely tried recently; but still do I hope that at the close of this appalling war we shall still be a strong England and able to indulge in some of those ideals that have stood us in good stead in the past: to take a notable instance, the welcome given to the French refugees who came to us after the Massacre of St. Bartholomew's Eve. These splendid people brought their art and crafts with them, settled among us, and became of us; and there are probably few in this room whose blood has not been enriched by the infusion.

I am wanting you, my friends in the trade, to adopt this principle in regard to those whom I am inclined to describe as the neo-lithographers. I invite you to let their influence have free course among you, so that we may build up a school of British lithography which, in the fierce competition of the nations, shall be without fear and without reproach.

When I last took up my pen to write on the subject of lithography the year 1910 was drawing to a close, and my purpose was to write the article on lithography in the then forthcoming edition of the "Encyclopædia Britannica." One is now surprised to find how much has happened in the short space of time that has intervened; but probably nothing has happened of equal importance to that which has occurred in regard to it since the beginning of last August, and I should seriously belittle my opportunity if I did not give a front place to this branch of my subject.

The United Kingdom of Great Britain and Ireland is probably the largest user of lithography in the world, and if the total of our national production and our imports were divided by the number of our population, we should be surprised at the sum per head that would be the outcome of the operation; but so great is the foreign competition that it is estimated by competent authority that 40 per cent. of this sum comes from abroad.

Now it is abundantly clear that the war will throw upon every trade burdens that will be felt for many years, and the paramount question for each trade is to ascertain what vantage can be secured from existing conditions that will enable it to meet the necessary charges that are being piled up against it. There is no remark so frequently heard as this: "Surely what can be done in Germany can be done here!" Can it? Let us turn the question about—it is always a safe process—and ask, What success has Germany when she endeavours to rival us in the finer counts of cotton piece goods, for which the humid atmosphere of Lancashire is so conspicuously suitable? What success has she when she endeavours to rival the product of Etruria and Worcester? Her efforts will find better recompense if employed in keeping up the quality of her own Dresden china. Can Germany rival Paris fashions or grow a Ribston pippin? It is a main point of my contention that nothing is to be gained by a slavish imitation of German methods, and that our aims will be better served by using our period of freedom from pressure by perfecting British work in every possible way, by educating our people to delight in the work for which our English artists and lithographers are so well suited, and at the same time learn all we can of that efficiency of administration that has stood the German lithographers in such good stead.

To descend from the general to the particular. Let me deal with the question of Christmas cards, of which we have heard so much of late. By far the largest user of such articles has been Great Britain, so that the British people have called the tune; what they have asked for has been a matter of evolution proceeding from the

valentines the modern cards superseded. These were of two types—such as when a tiny Baxter print of great finish was displayed on a vast piece of embossed paper, or when a quasi-comic idea was developed in a crude outline and vulgar colouring; and, needless to say, the more elegant idea went ahead the more rapidly.

If German printers had been left to themselves they would have kept on these lines, for the cult of high finish and the infinitely minute is their strongest point, and on these lines—in which everything is more or less a miniature—the English printer has little chance of attacking them successfully. For, in the first place, a tremendous quantity of carefully trained art labour is requisite, a quantity that is non-existent in this country, and a precision of register in vast sheets, generally 50 ins. by 40 ins., and that is almost hopeless in this country, owing to our more varying temperature, and more especially on account of varying conditions with regard to the humidity of the atmosphere.

It is possible to deal with the question of temperature, but it is a difficult thing to deal with the question of moist or dry atmosphere—that is practically to say of an easterly or westerly wind. Mr. Horace Hart, the well-known printer to the Oxford University, has, backed by large funds, brought about a condition in this respect by which he is able to do a very high grade of collotype in colour, but that is a very different thing from having the natural atmospheric condition as it exists in the great central plateau of Europe, on which the chief printing centres of Germany are located.

The absence of this quality in the air causes the English printer, for work of such close register, to prefer a sheet, say, 35 ins. by 25 ins., whereas a sheet of 50 ins. by 40 ins. is a frequent measurement abroad, and thus a sheet of more than double the area is printed with the same revolution of the machine.

The second point of vantage that the foreigner possesses is the much less cost, and, I must confess, the much better character of his transferring, by which is meant the putting on the large stone or plate the necessary repetitions of the originals that have been drawn on quite small sheets, and this transferring is a very important item in the total cost. The total volume of this work done in a German factory is very large, so that it is much cheapened by subdivision; a workman is constantly employed pulling the barest possible transfers, so bare that the solids generally have to be filled in on the stone or plate; this work is carried out by quite an army of girls, other girls having previously stuck up the transfers on the backing that is the size of the full sheet to be printed. This is work for which women are exceptionally well suited, but such employment would be contrary to general usage in this country, and, I imagine, would meet with sturdy opposition from the trade unions; but unless working arrangements of this sort can be made, the British printer will be hopelessly out of it, both with regard to cost and general efficiency.

When the sheet is what is called "stuck up" it is passed on to still another printer, who, in a large factory, spends all his time in pulling such sheets through upon the stone, always in a broadway press, which is a great essential, though at present little seen in our workshops. The plate then goes to yet another printer, who rolls it up and leaves it ready for the machine, and the result of all this subdivision of labour is that at a cost of 10*s.* a process has been gone through that would cost 30*s.* in most English establishments.

The strong point of English lithography is in working from original stones, as is done in our vast poster industry, and in nearly all such cases the work is done in mixed chalk and ink, instead of ink only, and this is much less expensive. This work, when printed by the offset process, secures an amount of finish that makes it a very effective substitute for the stippled work of the Continental artist.

When I was last in Leipzig I had full opportunity of seeing the large chromo-printing businesses in operation. In one of these I was glad to find the ubiquitous Scotchman in charge, and on leaving the artist's room I remarked on the large number of young men he had under him. "Do they receive much money?" I inquired. "No, no; they are nearly all volunteers." "What do they do when they have learned their trade?" "They go for their 'wander-year,' and then generally find work in America, and thus avoid military service"—and I felt thankful that the demon of commercialism had not yet led us into such devious ways of bringing up our youngsters in blind-alley occupations.

Mention has already been made of the vast nature and satisfactory condition of the poster industry in the United Kingdom; its progress in efficiency and quantity during the last two decades has been remarkable. The United States were in 1888 immensely in advance of

us, and this had largely arisen from the fact that the Storbridge Lithographic Company had the acumen to put that distinguished English artist, Mr. Matt Morgan, in absolute control. Morgan, apart from his work in the *Tomahawk*, was a wonderful scenic artist, and carried out two stupendously beautiful sets of scenes for pantomimes at Covent Garden, under the management of Charles Harris the elder. This theatrical gift led him, unfortunately for his art, into a groove, and all his work was of the stage — stagey. His figures and animals always seemed to be posing, as in the case of the huge posters done about this time for Barnum's first visit to this country with his show. Much has happened since then. England has gone straight ahead, and a recent collection of American work shown at the Printers' Exhibition in the spring of last year was beneath contempt. Can I account for this rapid progress? I think I can, and I attribute it to two causes—the artists have taken an intense interest in the matter, and the buyers of such advertising matter have almost invariably insisted on the name of the artist being on the picture when reproduced. Apply the same principle to the Christmas card artist, allow him to see it through the press, and one half of the much-talked-of Christmas card question will vanish into thin air.

A further immense advance will be made in this field on the day that the printer's name becomes visible on every card that has any pretence to be even a tiny work of art. The publishing houses are vast organisations, and they are jealous of giving to trade rivals information that may be useful to them, but what is to prevent them making their contracts with their artists and printers for having their exclusive output? It is a regrettable incident that something of this sort is creeping back into the poster and show card trade, and users, on the ground of perhaps saving trouble, are dealing with large organisations that employ a well-dressed traveller who knows all the tricks of his trade only too well, a well-known designer or two, and then exploit the printer to the obvious detriment of reproductive art.

There is a piece of beef figuring on the walls at the present time that has often sent me to my lunch prematurely; lithographically it is the work of a much-respected competitor of mine. The work of the artist must have been good, though, after all, it is only a piece of very "still life," but it took a master of his craft to execute it in lithography, and it appears a cruel irony that no mention of the firm's name appears on the poster.

As long ago as 1884 a very capable man, who had been brought up in Messrs. Marcus Ward's at Belfast, became manager of a firm of German origin, and he decided that for once he would let himself go and have a set of cards to his own liking and regardless of expense. He commissioned my friend Wilfrid Ball to make him thirty-six suitable sketches, and gave me a good price to lithograph them under the direct control of the artist. The result was a pronounced success, and the cards sold out immediately. But the real object of the manager remained to be seen, for he had a full sheet of the cards pinned behind his editorial chair, and I have had many a good laugh when he has called for a German printer to be admitted, despite my presence, and has said to him, "You recollect those landscapes that I gave you the other day; I want to show you what English landscapes really are," and he conducted him from Epping Forest to Burnham Beeches and Windsor Great Park, bright sunny bits every one, and finished up by saying, "Now don't give me any of your Black Forest stuff, for I won't have it!"

Although, for reasons of price, I received few further orders, I had ground for knowing that some German renderings of English landscapes were less horribly gloomy stodgy things than they would otherwise have been.

A couple of days before the breakdown in health that has deprived me of the pleasure of reading my own paper, the idea occurred to me that it might be a desirable effort to place before those present an example or two of the direction in which our thoughts might turn in view of the present situation. I had therefore given instructions that a subject by Mr. Wilfrid Ball and another by Signor Barberro should be lithographed on the lines that I have already suggested, with a view to presentation to the members of the audience. I especially stipulated that the drawings should be copied with some freedom, and that there should be no high finish attempted, my desire being to cut right adrift from the tightness which has been the *bête noire* of such work. It has never for a moment been my wish to suggest that a great number of my competitors could not do the work equally well, but I felt it desirable to supply my meal on the assumption that some of them would supply their malt, and that between us we might, by this co-operation, mark the advance

which I feel to be so near at hand and easily available.

These cards are printed by the flat-bed offset process of lithography, by which a sheet of rubber takes the impression from the stone, and then by a subsequent cylindrical pressure is made to yield up its colour to the sheet of paper, the object of this being to enable a satisfactory result to be secured on Whatman or other naturally grained paper. The method of lithography employed is that of chalk and ink mixed, a class of work that has always been typically British. The reason that it has not been applied to Christmas card work is that it is held to deteriorate in transferring to the necessary large sheet. My experience is that this is only a partial truth, and that if the chalk work is of the right sort it is quite possible to get beautiful transfers which, when printed by the offset process before described, will run the German work in this department exceedingly close, and secure a result essentially British at a moderate rate of cost.

The co-operation of artist and printer is the essential point, and if the former has neither the time, the gifts, nor the inclination, to put his work on the stone, and this is seldom possible when there are many colours, he should at least have an important voice in selecting the method of reproduction.

No two artists have got so much out of three or four colour work as Arthur Rackham and Edward Dulac; they have taken note of what the process can do, and each would seem to have concluded that it succeeded best when a result closely allied to "faïence" was aimed at. And I advise those who may draw for the lithographer to engage in their work on lines suitable to the method to be employed.

It is notable in regard to the lithography of the past, that, apart from those instances where artists have worked direct on to the stone or grained paper, those prints are most valued where an artist's work has been used as a suggestion only by a lithographic artist of repute, and the finished work has been an unmistakable print. The crowning vice of the chromo-lithograph of mid-Victorian days was that each print masqueraded as an original; and the accidents of the brush were, to put it in the manner of Dr. Marigold, reproduced as "large as life and twice as beautiful."

My constant advice to the younger men that I meet is that a drawing must be treated as an inspiration; treated with respect by all means, but kept as an inspiration only. It was in that way that the great engravers of the past worked, and it is for that reason that the prints from their plates are so highly valued at this time. A return to this state of affairs in lithography will be the best way to show that the House of the Interpreter, in which so many of us lead laborious lives, has not been built in vain, and that is the spirit in which these two little specimens have been produced.

What is passing through the minds of men is, whether we can not only secure German work during the period of the war, but hold it when the war is over; this depends on the way we use our present opportunity. It is not difficult to foresee that at its close the country will be flooded, as far as legislation allows, with the production of the German printers, and that they will be especially keen for work, and if we have only met the opportunity by laying down additional plant there may easily be over production and a period of depression. There will obviously be a period during which a great preference will be given to home-produced work, but the desire for good value will assert itself with constantly increasing power, and will eventually be our undoing unless we have used our chance in other ways than this.

The needs of the moment are more thought, and perhaps less work, on the part of those who lead; a closer co-operation between artist and reproducer; increased technical education that we may have a higher class of art workers; the abolition of blind-alley occupations; and, mind you, there is such work that has nothing to do with the young people—there is the mechanic's blind alley that ends in the *impasse* of £2 a week, or the curate's blind alley of £150 a year. There must be more rising from the ranks all round, and those who rise should ever be reminded by those in the higher command that he who would direct human beings must himself be humane.

There will arise much improvement in British work when less of it is anonymous; it is this anonymity that has stayed the progress of Christmas card work, and I look forward to the time when the suburban lady will inquire of the shopkeeper, not whether he has the booklet or card of this publisher or that, but, "Have you anything dainty by Arthur Rackham, Hugh Thomson, or Willy Pogany"? "Have you any screamers by Hassal, Cecil Aldin, or Louis Wain"? I have mentioned one case where the personality of the artist worked like magic,

but there have been far too few of such instances; but it is a pleasure to recall series by Kate Greenaway, Randolph Caldecott, Phil May and Frank Paton, which have, by their success, done something to confirm my contention. Nothing can be more clear than that if artists secured all the recompense of their work, and not the cash value only, there would be a great accession to the ranks of those who help in producing these unconsidered trifles, and that there would then arise more freedom, less working to type, and factory-made art would cease to exist.

DISCUSSION.

THE CHAIRMAN (Mr. Carmichael Thomas), in opening the discussion, said that no one was more qualified than the author to speak on the subject, because he and his firm had, for the last fifty years or more, been constantly engaged in reproducing pictures and drawings by means of lithography, and some of the most beautiful prints in existence had been the result of their labours. Some of the old lithographs were very charming reproductions. Many present would remember the reproductions of the Birkett Fosters and Hunts, which were practically facsimiles of the originals, and were far more attractive and artistic for the decoration of the house than the second-rate water-colours which many people put on their walls because they were originals. The soft colours and touches of water-colours, pastels and miniatures were very well reproduced by the good lithographic artists of the day; but, in his view, the strength and vigour of the Old Masters, such as Velasquez and Rembrandt, were better reproduced by the four-colour process of the present day, although Mr. Pennell would probably not agree at all on that point. He was glad the author had referred to the German question, because it was very disappointing for anyone who was interested in printing and prints to know that so much of the work was done in other countries. Mr. Joseph Goodman, in a most interesting paper which he wrote for *Penrose's Annual*, stated that in Nuremberg there existed a factory, employing 1,700 people, constantly producing lithographic work, the whole of which came to England. What a splendid opportunity there was at present for the English lithographers and artists to capture some of that trade! He did not know that the very descriptive saying "cheap and nasty" applied to anything with more truth than in the case of German lithographs. Some time ago, when walking through Kent with an artist who had painted many popular pictures, they entered an inn for refreshment and found hanging on the walls a horrible reproduction of that very artist's work, which was quite unauthorised and a perfect disgrace to him. Personally a reproduction of a drawing gave him more pleasure than the reproduction of a picture. He was thinking particularly of some of the delightful old lithographs that were printed in two printings, one a black reproducing the pencil work, and the second a buff tint with the whites cut out. It gave a charming effect, and he was glad to see that a certain amount of work was done in that way at the present time, both in landscapes and portraits.

MR. JOHN COPLEY thought that lithography had one use for artists, and quite another for a much larger public than artists generally dealt with, and that there was a great danger of confounding those two uses. While lithography could provide for both, the two fields were absolutely distinct. The author had covered one of them; the members of the Senefelder Club covered the other, and if lithography was to progress both commercially and artistically it was essential that the two fields should be kept rigorously apart. It was necessary to realise that one way of drawing on stone, which was the way that lent itself to artistic work, was not capable of infinite multiplication or rapid printing; therefore it did not come within the author's scope. The beauties that an artist wished to retain were beauties that were lost when they were rapidly produced. On the other hand, lithography had an enormous function in providing beautiful things that could be reproduced in large numbers and quickly, and the author desired that function to be made better and more artistic now that Germany was out of the way, and artists could co-operate in bringing that about; but the two must not be confounded, as there was a danger they would be at present. Colour work was perhaps the great field in which lithography of the commercial sort could progress. Artists had tried hard to make colour lithographs, but so far had failed; but for colour work on a large scale it was probably the best medium that existed, and he hoped those concerned in it would go ahead and produce better results than the Germans had achieved.

MR. G. W. JONES, after expressing his regret at the enforced absence of the author, who was a true craftsman, passionately fond of his calling, and who sought that everything that went from his workshop should be worthy of himself, said he wished Mr. Vincent Brooks had referred to the chromo-lithography of the past. Twenty-four or twenty-five years ago some wonderful work of that nature was produced by an eminent Edinburgh firm, but it had been a source of regret to him to find that since that time they had been obliged, through the introduction of the new methods of colour-printing, to depend largely upon them. He had always been a passionate admirer of chromo-lithography, and the excellence of some of the work was due to the fact that the painter did not feel it beneath him to go into the workshop and finish off the various stones before printing was commenced, and even sometimes supervised the printing. It was the spirit of harmonious working between

the artist and the reproducer that made for the beautiful pictures which had been, and still were, the glory of the chromo-lithographer. He hoped they would be able to get back to that high standard, because only by that means would they be able to maintain their position against the Germans.

Mr. Frank Colebrook thought the statement the Chairman had made in reference to the article written by Mr. Goodman was not quite accurate. He believed the correct version was that on the occasion of the visit of Dr. Reynolds, the head of the Manchester Technical Schools, to the works in Nuremberg the whole of the work then being done was for the British market. That was not inconsistent with the possibility that it was habitually so, but he thought it was hardly likely that that would be the regular condition of affairs.

Mr. Joseph Pennell thought the Chairman had made a mistake at the beginning of his remarks when he said that lithography was a method of reproduction. That was just what it was not, and never had been. Lithography was a method by means of which an artist could express himself in his own way from beginning to end; and the trouble with British lithography had been all the way through that the reproductive person had somehow crawled in and thought he was IT. That was the reason British lithography was so contemptible. The author had stated that there was nothing more contemptible at the last Printers' Exhibition than the American work, but personally he did not think there was anything so bad as the British posters, British post-cards, and everything else that was produced by British lithography; it was absolutely beneath contempt. Lithography was an original art for artists and not for other people. That other work could be done in reproductive lithography everyone admitted; it had been done in a wonderful fashion, but when a third man intervened the result was awful. There was exhibited on the wall of the theatre a lithograph done by a most distinguished Belgian artist, who made the drawing after three weeks' study at the London County Council School, which proved how little special genius or instruction was required. It absolutely proved that lithography was an art for artists and for nobody else. The important point was to carry on the tradition or the method which Senefelder invented. The artist alone produced all the wonderful work that had been done in past years. Mr. Copley had referred to the two kinds of lithography, commercial work, which could be beautifully done, and which was worthy of all recognition, and the artistic side of lithography. Lithography was even a more original or autographic method than etching or wood-cutting, because in lithography every line that the artist made, either on the paper or stone, he saw, and when those tones were printed they represented entirely an artist's work, there being no intermediary. The lithograph was not a reproduction, as the Chairman said, but a multiplication of the artist's own design, and the trouble was that the middleman, who was a most ingenious and wonderful person, had come in and copied his designs. He was afraid there would be a fearful row if anybody "translated" his work, as the author called it—in fact there had been rows in connection with his work for the *Graphic*, to which he had had the honour to contribute, owing to the photo-engraver and the printer coming in. In lithography the artist should do the whole of the work himself, and that was the reason the Senefelder Club was promoted and had prospered. A good many secrets had existed in connection with lithography, but when they were solved they were found mostly to be composed of stale beer and lemon juice, which were two of the most vital factors in making lithographs. Senefelder said at the end of his book that the lithographic method was a most wonderful thing, to which he hoped many great and brilliant artists would turn their attention; they would do great work, and the day would be blessed on which he invented it; and he (Mr. Pennell) quite agreed with the statement.

The Secretary (Sir Henry Trueman Wood) said the audience would agree with Mr. Pennell's remark that lithography was an original art, but it was also a commercial business, and the paper was written from that standpoint. Lithography was of importance as a means of reproducing artists' work as well as a means of enabling them to give their own ideas to the world.

Mr. E. J. Sullivan said that the artist had always had some sort of quarrel with the reproducer. In the time of the Chairman's father a great effort was made to bring the wood engraver into touch with the artist; but when speed in multiplication was a necessity it was impossible for the artist himself to carry out his work for the purpose of reproduction. Very shortly after Senefelder's time, Daumier, in Paris, drew a cartoon per day on stone, and these were printed on one side of the paper, type occupying the other side. He mentioned that as an example of the forcible means lithography possessed for giving an artist a chance of absolute autographic self-expression without any intermediary at all except the printer. Twenty-five years ago, when the *Daily Graphic* was first started, and when wood illustration was not a lost art, he remembered that at one end of the studio there was a long bookcase in which wood-blocks were kept for fear the process might break down. A means existed as far back as 1820 by which an artist could express himself in print without a wood-block or any intermediary at all, and he did not know why that lithography went out unless commercialism killed it as a means of artistic expression. Although the Dalziels, the Thomases, the Swaines,

and others presented the artist's work in a magnificent form there was a mind in between the artist and the multiplication of his work. No words could express the exquisite delicate, silvery beauty of the drawings on wood in pencil by Boyd Houghton exhibited at South Kensington, but delicacy disappeared in a reproduction from a wood-block, and a sense of force was apparent which was almost brutal in its insistence. In lithography all those minor subtleties and delicacies were obtained that wood and copper could not possibly give; the stone was capable of giving gradations in length and width of line such as were obtained with a pen, and there was no mind between the artist and the product.

The Chairman, in proposing a hearty vote of thanks to the author for his interesting paper, said he was sure it was also the wish of the audience that the Secretary should convey to him their regret at his absence, and their best wishes for his speedy recovery. In reference to the remarks of Mr. Pennell and Mr. Sullivan, there must always be some amount of disappointment if a middleman came in. He could quite understand the feeling of disappointment an artist must have when he saw his drawing reproduced by wood engraving; he knew that well because he was an old wood engraver himself, and that was where the advantage of lithography came in over wood engraving.

The resolution of thanks was carried unanimously, and the meeting terminated.

THE SILK INDUSTRY OF SYRIA.

The silk industry of Syria has been from ancient times one of the country's principal sources of wealth, but owing to the lack of labour caused by the emigration of thousands of Syrian peasants to North and South America, Africa, and Australia every year, and to the fact that the lace-making industry took up the greater part of the time of the peasant women in the Lebanon, the amount of silk produced in late years has been considerably reduced. The eggs used for hatching silkworms are imported from the Department of Var, France. Syria formerly imported 270,000 to 300,000 boxes of eggs annually, and about 30,000 to 40,000 boxes of native eggs were produced, each box containing 25 grammes net weight of eggs, which yield from 55 to 82 lbs. of cocoons. The imports and production of eggs have been reduced yearly, and many proprietors of mulberry groves have been obliged to cut down or root up their mulberry trees and replace them with orange trees. When the season is good and the trees grow a considerable quantity of leaves, the demand for eggs is increased, according to the American Consul-General at Beirut, with a corresponding increase in price. The usual price of eggs per box is from two to three shillings, rising to eight shillings when the trees are in full foliage, with plenty of large juicy leaves. On the other hand, when the trees are bearing only a small amount of leaves, and these leaves are small and dry—which may happen if the spring is a very dry one—not all the eggs imported can be used, and a great many boxes have to be destroyed, with a consequent decrease in price. The eggs are shipped from France every year on or about August 15th, according to the climatic conditions, and reach Beirut about the first week in September. They are kept in Beirut until the end of October, and then are distributed among some of the monasteries in the Lebanon mountains, up near the snow-line, where they are kept in cool places until the hatching season, which begins in March. March 19th is the day fixed by all the silk producers for putting their eggs in incubators. After hatching they are tended in special huts made of rushes, reeds, grass, straw, and sticks until May 10th or May 15th, according to the climatic conditions, when the first worms, after having been fed liberally upon mulberry leaves, spin their cocoons The prices of cocoons always depend on the prices of raw silk at Lyons. In 1913 the prices ranged from 1*s*. to 1*s*. 2*d*. per lb., according to quality. There are over 150 factories in Syria that make a business of reeling the raw silk from the cocoons and selling it as thread or yarn. Some of these factories are always able to obtain specially good prices for their brands, which are known in Europe for their uniform fine quality. The other brands are classified as seconds and thirds. All the silk manufactured in Syria is made into skeins of a standard size used by French manufacturers of silk stuffs, and packed in bales weighing 220 lbs. each. Every year the silk merchants in Lyons open bank credits in favour of the silk manufacturers in Syria, and the silk manufacturers begin to draw on these credits at the beginning of the cocoon season, binding themselves to send a maximum quantity of silk to be sold for their accounts by the Lyons merchants. The total production of silk in Syria during 1913 was 770,000 lbs., and Beirut exported 550,000 lbs., which was about equal to the exportation in 1912. It is felt in many quarters that this industry has already reached its height, and that the production of silk will continue to fall off during the years to come.

THE SEA ROUTE BETWEEN ENGLAND AND NORTHERN SIBERIA.

Mr. Lied, whose commercial cruise in 1913, in company with Mr. Nansen, from Norway to the mouths of the Siberian rivers attracted so much attention and formed the subject of Mr. Nansen's work "Through Siberia," is now in Petrograd, making preparations for a third trip, and is expected to return to London in March next for the purpose of completing arrangements. Mr. Lied's second expedition took place last year just at the beginning of the war, but owing to the general excitement at the time it failed to attract much attention. Nevertheless it was particularly

successful. The ships that took part in the expedition were the two cargo steamers "Ragna" and "Skule," 2,450 and 1,850 tons respectively, four river steamers, 520 h.p. and 210 h.p., and two barges of 700 tons each. One of these contained two 150 h.p. river steamers, in pieces, to be put together on arrival in Siberia, and built by Thornycroft's firm.

The two cargo steamers had been chartered of the Siberian Steamship Manufacturing and Trading Company by the Russian Government for the conveyance of a full cargo of cement, iron and steel, to be delivered on the Yenisei for railway purposes. The river steamers and barges were bought by Mr. Lied in Germany, on account of the Russian Government, for future service on the Obi and the Yenisei. As they had to be specially strengthened for the voyage, and there was very little time to spare, the ships were registered in the German Lloyd's, and as a matter of formality had to make the voyage to Siberia under the German flag. This, of course, was before the war. The repairs were hurried through at Hamburg, and the ships and the river fleet left Cuxhaven on July 30th, just sixteen hours before the ships would have been confiscated by the German Government. They then proceeded under their own steam to Tromso. The two big cargo steamers were to load 15,000 barrels of cement in Aalborg, Denmark, and it was with the greatest difficulty that the ships succeeded in getting out thence on August 9th and making for Tromso. There Mr. Lied joined the expedition, and on August 16th a start was made for Siberia.

The expedition passed through the Kara Straits on August 24th, after having supplied the river fleet with coal from the big steamer off Vaigatch Island at the entrance of the Kara Sea. Here the expedition was troubled with fog and also with much ice. After three days, however, clear water appeared, and on August 30th the river steamer "Marie" (210 h.p.) and the barge "Skalk" were dropped at the mouth of the River Obi for their 3,000-mile journey up the river to Tomsk. With the rest of the fleet the expedition proceeded to Dickson Island, outside the mouth of the Yenisei, where they arrived on September 1st. Here they found the Russian rescue expedition, sent by the Government, in charge of Captain Sverdrup, to search for the lost Arctic expedition under Brusiloff and Rusanoff. Sverdrup's ship, the "Eclipse," was stranded on a rock. Mr. Lied's party discharged some of the cargo on to the decks of his steamers and towed the "Eclipse" off, after two days' work, after which she proceeded northwards, and should now be frozen in somewhere near Cape Chelyuskin. Mr. Lied's expedition then proceeded 180 miles up the Yenisei River to the appointed loading place, Nosonofski Ostrop, where the river fleet of sixteen vessels was awaiting them. Fourteen days were spent in loading and discharging, the return cargoes consisting of timber, hemp, flax, hides, etc., which were eventually landed safe and sound at Hartlepool. The river steamers on the Yenisei were taken over by the representatives of the Russian Government, and the whole fleet of twenty vessels returned to the interior for their 2,000-mile journey to Krasnoyarsk on the Siberian railway. The Lied expedition, with its two cargo steamers, the "Skule" and the "Ragna," commenced its return journey on September 19th. A quantity of ice was encountered north of White Island, and the temperature went down to 6° C. below zero. But the return journey was far more expeditious than the out journey, having occupied only eleven as against nineteen days, although very rough weather was experienced off the Norwegian coast.

The success of this second expedition has thus clearly established the practicability of the Siberian route from England, and its convenience at a time when the Baltic is impracticable is fully acknowledged in both Russian and English shipping circles.

SALT IN THE STATE OF OKLAHOMA.

By Chas. N. Gould, Ph.D.

Salt is present in many parts of the State of Oklahoma. Deep drilling in practically all parts of the State reveals the presence of salt water, contained usually in ledges of sandstones, and encountered at various depths. It is in the western counties, however, that the salt is the most abundant. This is the region of the red beds, of Permian age. The red beds consist largely of red shales and clays, with interstratified ledges of gypsum, dolomite, and sandstone. There are in this part of the State seven regions of salt plains or salt springs, points where a strong solution of salt brine escapes from the surface and flows away in streams.

The largest salt plain in Oklahoma is situated near the town of Cherokee, in eastern Alfalfa County. This plain is twelve miles long, north and south, and six miles wide, east and west. The surface is flat and level as a floor, and is covered for the greater part of the year with an incrustation of white salt crystals, so that from a distance the plain has the appearance of a snow field. During heavy rains these salt crystals are dissolved, and the flat surface of the plain is then a brownish red colour. There are no strong springs on this plain. However, a hole dug anywhere in the surface of the plain will be filled, within a few minutes, with a strong solution of salty brine. The water escaping from this plain flows into Salt Fork River and contaminates the stream.

At the base of the Gypsum Hills, which extend north and south across Western Oklahoma, there are three separate salt plains. Two of these are in the valley of Cimarron River, between Harper and Woods County. The largest of these plains occupies an area of about eight miles in length and two miles wide, lying along both sides of the river, and in a cove to the south of the stream. A number of springs of strong salt water occur in this cove.

The most noted salt plains in Oklahoma are in

northern Blaine County. The water at this place issues from two narrow canyons, which have been eroded in the Gypsum Hills. The streams from these two canyons unite and form Salt Creek, a tributary of Cimarron River.

Three salt plains are located in the south-western part of the State, two of them being in northern Harmon County and one in eastern Beckham County. The water in these springs issues from the base of the Greer Gypsum formations. The water from practically all of these springs is a saturated solution of salt brine. The amount of solid matter is so large that it is deposited on exposure to the air. Around many of the springs hummocks of salt have been built from the evaporation of the water, something after the manner of the deposits of sinter, in the vicinity of geysers.

For many years salt has been manufactured in a primitive way at these various plains, either by solar evaporation or by boiling in kettles. Some years ago an attempt was made at the Blaine County plain to produce salt in a commercial way. A mill was erected and was in successful operation for some months, when the property was purchased by parties interested in producing salt in an adjacent State, and shut down.

It has been estimated that the amount of salt water in western Oklahoma would produce one hundred cars of salt per day. At the present time none of this material is being utilised.

ARTS AND CRAFTS.

The Board of Trade Exhibition of German and Austrian Textiles.—The little exhibition of cotton and other fabrics of German and Austro-Hungarian manufacture held for two days at the end of last month, under the auspices of the Commercial Intelligence Department of the Board of Trade, at 32, Cheapside, was of hardly less interest to those interested in design for textile fabrics than to manufacturers. Quite a good collection of printed materials (mainly cotton and linen) had been arranged, and it was possible to gain some insight into the kind of German and Austrian work which has been coming into this country and apparently finding a market here. How far manufacturers (even should they so desire) will be able in the near future to produce work on German or Austrian lines depends, of course, in no small measure on the dye-stuffs available, the stocks of colour already on hand, and the success of the efforts to provide English substitutes for the German chemicals on which we have so largely, and, as it seems, so short-sightedly, depended. Presumably, however, while the primary object of the Board of Trade may have been to show manufacturers what is wanted at once, there lay behind it a desire to enable British makers to be ready and on the spot at that later date when the war should be over. In the main the German and Austrian designs have to be considered apart, for, whilst the German goods are for the most part purely commercial, those of Austrian origin appeal deliberately to a smaller and more consciously artistic public.

German Textile Designs.—It is apparent that the success of the German goods must be attributed to something other than their design. The patterns on the whole, whether cotton prints for furnishing purposes or simple dress and shirting patterns, were singularly lacking in distinction. The more ambitious work was up to a very fair technical standard; there were a few shadow effects, and many of the devices, such as the use of a slightly figured ground, of which our cotton printers have been making use, are part of the common stock of their German competitors. On the other hand, the designs were singularly dull and commonplace. Many of them were a German rendering of a French type of design which, though effective enough when treated with the Latin lightness of touch, is not well adapted to the heavier Teutonic handling. Others, again, are evidently inspired—to put it very mildly—from English sources. Indeed, in one or two of the most satisfactory patterns the source was so obvious that one was able to recall the exact pattern from which they were derived. But the English design had been printed on a cloth of a considerably better quality. That is probably the key to the whole situation. German goods of this class have presumably been bought over here simply and solely because they were cheap.

Austro-Hungarian Designs.—The Austro-Hungarian designs were on a totally different plane, and though the fact that they are very largely printed linens suggested that they have had a much more limited vogue, they were well worthy of study both for their own sake and because they suggest lines along which in the present crisis it might be possible for British producers to work. Not only those who have been in Austro-Hungary, but also those who have attentively studied the *Studio Year-Book*, have been conscious of the strides made in recent years in the Dual Monarchy in the direction of design. Many of the patterns have shown very obvious defects, some of them (especially those which have been most to the front in this country) have had marked affinities with what seems to some people rather frenzied futurist work, but for all that there has been a genuine movement towards direct, simple and individual design. The printing of these Austrian fabrics is often rather brutal. The outlines (of which great use is made) are frequently inordinately thick. The patterns sometimes suggest stencilling rather than printing. These things may perhaps be regarded as their defects, and against them must be put some undoubted qualities. The colour-schemes are new and very interesting, and it is surprising what light, fresh and distinguished effects have been obtained in simple patterns in which a thick black or other dark outline is the main feature, enclosing here and there touches of

brilliant colour. In some of the patterns shown at Cheapside the addition of a kind of half-tone grey colour helped towards a very satisfactory result. In a different field another notable piece of work has been done. This is the copying in printed cotton handkerchiefs and scarves, apparently intended for the East Indian market, of "battik" work. Whatever we may think of imitation as such, the colour effects of these things are some of them extremely good, and one wonders whether in work of a different class something analagous to the result obtained by the imitation of the running which takes place where the stopping-out wax has cracked might not be introduced with very satisfactory results.

It is to be hoped that British designers will profit by the very useful and inspiring collection of printed fabrics provided for their inspection by the Board of Trade. It is little exhibitions of this kind which ought to give them just that impetus which they want.

The Work of the Central School of Arts and Crafts.—A very wide field is usually covered by the exhibition of the work of students of the Central School of Arts and Crafts in Southampton Row, and the exhibits this year represent the principal crafts connected with book production, silversmithing and woodwork, as well as writing and illuminating, china painting, stained glass-work, embroidery, miniature painting, design. drawing and modelling. The show is always an event of considerable interest, for it enables the public to see what is being done at the School which, barring the Royal College of Art—which is after all a national rather than a local institution —is the most important of its kind in London. It is consciousness of this fact, perhaps, which leaves the visitor with a certain feeling of disappointment. The collection always includes a fair proportion of good work, but it is almost impossible not to regret that the best works shown have for the most part so little relation to the more important manufacturing industries of the country. The studies preparatory to design on view this year were certainly quite on right lines, but the more advanced original patterns, though in some respects more competent than those which used to be exhibited some years ago, were not particularly interesting, and there were very few of them. There was less woodwork than usual, but that may have been due in some measure to the war which has hit this pre-eminently London trade very hard indeed. The exhibits connected with book production—again an industry closely connected with London—were up to their usual standard. The printing showed that the students were being trained in the best principles of their trade, and some of the book illustration was very clever. The silversmithswork was, on the whole, less interesting, and a few of the objects shown suggested that the particular students responsible for them were more anxious to emphasise that their work was "handmade" than was quite consistent with the best art. The stained glass was in the main satisfactory, though some of it appeared to be rather too heavily painted. That may, however, have been due to the way it was exhibited. Stained glass is always difficult to judge out of its position, and at the Central School, at any rate by artificial light, only about a third of the examples shown were really well lit. A large number of the cases in the first room were devoted to embroidery, and the collection included also an elaborately embroidered altar frontal. Some of the stitchery was very interesting, and the little panel of St. John, with the face worked round and not straight, would have been quite satisfactory had the mouth been rather better managed. For the rest, while there was fine needlework in abundance, it seems a pity that the students who, it is to be hoped, are not quite all amateurs, are not encouraged to perfect themselves in a larger variety of methods. There is a comparatively coarse work which is by no means to be despised, and which allows needlewomen to attempt feats which could not be accomplished in finer stitchery. Further, appliqué is a kind of work which certainly merits some attention. The writing and illuminating were, as usual, up to a very high standard, though some of the more advanced students are a little inclined to over elaboration, and seem to forget that in an initial the thing of primary importance is the form of the letter itself. Unless that is right, added ornament is really wasted The students have learnt to choose their script and writing from a wider area than formerly. Many of the examples were very good, and the exhibits were far less after one model than they used to be. It is to be regretted that a school of this description should have been content to label so many of the works shown at an exhibition which was to last approximately a fortnight with untidy little bits of paper on which the exhibitors' names had been written apparently post haste by someone whose handwriting was not peculiarly beautiful or legible. It detracts from the effect of the work, and suggests a want of workmanlike method and order Finally, interesting as the exhibition was, its value would have very much increased had some indication been given of the status of the various students. It is difficult to estimate the real merit of work without knowing whether it is the output of a young trade scholar or a fully qualified workman, a casual amateur, or a teacher or student in training.

CORRESPONDENCE.

THE ECONOMIC DEVELOPMENT OF BRITISH EAST AFRICA AND UGANDA.

I listened with much interest to Major Leggett's paper on the Development of East Africa and Uganda, and I quite agree with his view that in looking to the future of East Africa the two

Protectorates must be dealt with together. As general manager of the Uganda Railway I had great opportunities of seeing the countries served by the railway, and by the steamers on the great lakes at the head of the Nile, and I endorse the views so ably expressed for the necessity of improved communications.

The development of traffic during the period when I was in East Africa was most promising, and called upon the capacity of the railway to the utmost. Much has already been done to improve the working of the railway and marine services, but as facilities are given, traffic increases and keeps the railway busy.

Survey parties are in the field for an extension of the railway to the west from Nakuru across the Uasin Gisho plateau, where available lands are already mostly taken up, and thence across the rich southern slopes of Mount Elgon to Mumias; and one hopes to see, in some ten years' time or perhaps a little more, rail-head carried right round the head of the lake and on into the Congo by the southern shores of Lake Albert and eventually junction with the railway from Stanleyville, and thus forge one more link in the chain of the Cape-to-Cairo Railway. The route would lie along the northern watershed of Lake Victoria, passing Mbale, the trade centre of a very rich cotton district, to Jinja, the eastern terminus of the Busoga Railway now connecting the Lakes Victoria and Kioga and serving a very large area under cotton. It is at Mbalo, I think, that any further extension northwards of the Cape-to-Cairo system should take off. I should like to note here that in my opinion the north and south lines will at no time carry any great traffic in mid and central Africa, but will act mostly as feeders to the east and west railways.

A bridge across the head of the Nile near the Ripon Falls will be an easy matter, and a line from Jinja to Kampala will serve a very rich country already under cultivation. From Kampala the line will run in an almost westerly direction to find a possible crossing of the waters flowing into the southern end of Lake Albert, and open out much good country that is already being broken up by settlers.

The east coast is the natural outlet for all traffic from around Lake Albert, and we must see that we put our communications and harbour in fit condition to deal with the produce offering. The natural features of Kilindini lend themselves to an excellent system of harbour construction, for which designs have already been got out. The country has now reached the producing stage, and after the war it will be essential that a big push be made with the improvement of communications. Any moneys spent to this end will rebound to the credit of the Empire in cheapening the cost of raw materials and in opening out fresh markets for home manufactures.

H. B. Taylor, M.Inst.C.E.

22, Cromwell Crescent, S.W.

GENERAL NOTES.

Tropical Agriculture.—The Proceedings of the Third International Congress of Tropical Agriculture, which have just been published (London: John Bale, Sons & Danielsson, 10s. net), form a substantial volume of over 400 pages. The volume is edited by the honorary secretaries of the Congress, which, it will be remembered, was held last June at the Imperial Institute. This was the first time the Congress had been held in London, and the result was most successful. More than one hundred and fifty papers, coming from authorities in fifty different countries, were presented to the Congress, and important discussions took place on several of the principal problems connected with tropical agriculture. Abstracts of the papers and full reports of the discussions are printed in the Proceedings, together with the address delivered by the president of the Congress, Professor Wyndham R. Dunstan, C.M.G., LL.D., F.R.S., Director of the Imperial Institute, and President of the International Association for Tropical Agriculture. Amongst the subjects dealt with in the Proceedings are Technical Education in Tropical Agriculture; Organisation of Agricultural Departments in Relation to Research; Agricultural Credit Banks and Co-operative Societies; Sanitation and Hygiene on Tropical Estates; Legislation against Plant Diseases and Pests; Fertility of Soils in the Tropics; Variation in Plantation Rubber; Cotton and Cotton Cultivation; Jute and Hemp Fibres; Cereals; Sugar; Cocoa; Tobacco; Oils and Oil Seeds.

Indigo Conference.—The Indian papers report that at a meeting of the Supreme Legislative Council on January 12th, Sir Robert Carlyle (Revenue Minister), replying to a question, said: "Natural indigo has undoubtedly suffered severely from competition with the synthetic product, and the Government of India are at present considering to what extent and in what manner assistance can be rendered to growers of indigo. To enable them to come to a decision it has been arranged to hold a conference shortly in Delhi."

Increase of Shipping at Rotterdam.—The number of vessels entered at the port of Rotterdam in 1913 was 10,527, with a net tonnage of 13,047,000 tons, against 10,477 with a net tonnage of 12,360,000 in 1912. The average tonnage per ship increased from 1,179 in 1912 to 1,239 in 1913, which increase was more than in any previous year. In this connection attention is called to a statement made by the president of the Hamburg Chamber of Commerce, in which he admitted that although Hamburg is still ahead of Rotterdam in tonnage of ships, but with an annually decreasing percentage, Rotterdam is already ahead of Hamburg as regards the quantity of goods handled. The inland shipping increased from

158,673 ships, with a tonnage of 29,254,000 in 1912, to 161,948 ships with a tonnage of 30,486,000 in 1913. The number of ships arriving at New Waterway (Rotterdam) in 1912 was 11,317 of 13,473,000 net tons, and 11,448 ships of 13,915,000 tons in 1913. In 1912 there arrived at Antwerp 6,978 vessels of 11,697,000 tons, and in 1913, 7,056 vessels of 12,022,000 tons. This shows that the New Waterway had 4,387 vessels, with 1,893,000 registered tons more than Antwerp.

Coconut-water as a Rubber Coagulant.—An important discovery has just been made in the use of coconut-water as a rubber coagulant, according to the United States Consul at Colombo. Millions of gallons of coconut-water which now runs to waste on estates in copra drying and desiccation mills, can be utilised as a profitable by-product, besides producing a superior coagulant in making rubber. Details of the process are not now available, but it is understood that the coconut-water is allowed to ferment for four or five days, after which it can be used immediately for coagulating latex. One to two ounces of the fermented liquid will coagulate one pint of pure latex. It is said to produce a better rubber than that procured from the present method of using crude acetic acid, especially so far as colour goes, and clearer than that obtained from the cocoa-fermentation acid treatment. Experiments are being carried on to determine how long the liquid will keep, and how practicable it will be to transport it from the coconut plantation to the rubber estates.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock (except where otherwise announced):—

February 17. — Arthur Wilcock, "The Decorative Textile Industries and the Designer's Relation thereto." Sir Charles Waldstein, Litt.D., Ph.D., will preside.

February 24.—W. J. Ashley, M.A., M.Com., Ph.D., Professor of Commerce in the University of Birmingham, "The Economics of the War." The Right Hon. Sir George Houston Reid, G.C.M.G., D.C.L., K.C., High Commissioner for the Commonwealth of Australia, will preside.

March 3, at 4.30 p.m. — William Poel, "Shakespeare's Profession." Sir Squire Bancroft will preside.

March 10.—J. W. Gordon, "Patent Law Reform and the War." Dugald Clerk, D.Sc., F.R.S., will preside.

March 17. — H. M. Thornton, "The Industrial Uses of Coal Gas."

March 24, at 4.30 p.m.—Lady Lugard, "The Work of the War Refugees' Committee."

Indian Section.

Thursday afternoons:—

March 18, at 4.30 p.m. — Lieut.-Colonel A. C. Yate, I.A. (retired), "The Indian Army."

April 15, at 5 p.m. — Perceval Landon, "Basra and the Shatt-ul-Arab." The Right Hon. Earl Curzon of Kedleston, G.C.S.I., G.C.I.E., will preside.

May 13, at 4.30 p.m.—M. M. S. Gubbay, I.C.S., "Indian Trade and the War."

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

March 2.—David Lindsay (Leader of the Elder Scientific Exploration Expedition, etc.), "The Northern Territory of Australia: Past, Present, and Future."

May 4.—S. Chas. Phillips, M.S.C.I., "The Empire's Resources in Paper-making Materials."

Dates to be hereafter announced:—

T. Thorne Baker, "The Industrial Uses of Radium."

Frank Baines, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

E. W. Hulme, "Patent Law."

Roger Fry, "Post Impressionism in Design."

C. H. Sherrill, "Ancient Stained Glass."

A. S. E. Ackermann, B.Sc., Assoc.M.Inst.C.E., "The Utilisation of Solar Energy."

Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

Augustus Vernon Harcourt, D.C.L., LL.D., D.Sc., F.R.S., "On an Economical and Smokeless Grate, and on the Measurement of the Efficiency of Open Grates."

Cantor Lectures.

Monday evenings, at 8 o'clock:—

M. H. Baillie Scott, "House Building—Past and Present." Three Lectures.
March 15, 22, 29.

David Sommerville, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.
April 26, May 3, 10, 17.

FOTHERGILL LECTURES.

Monday evenings, at 8 o'clock:—

PROFESSOR VIVIAN B. LEWES, F.I.C., F.C.S., "Motor Fuel." Three Lectures.

Syllabus.

LECTURE I.—FEBRUARY 15.—*Petrol.* Its production and properties—The composition and grades of petrol—Transportation, storage, and distribution—The dangers of petrol—Calorific value, and how far it is a basis for comparison—The properties essential in a good motor fuel—Vapour tension and fractionation as indicators of the value of a petrol—Supply and demand.

LECTURE II.—FEBRUARY 22.—*Petrol Substitutes.* (*a*) Definite compounds—Benzol and alcohol. (*b*) Mixtures—How far mixtures of heavier grades of petroleum with spirit can be used. (*c*) The "cracking" of heavier fractions of petroleum into spirit—The researches upon which such processes are based, and their teaching.

LECTURE III.—MARCH 1.—"*Cracked*" *Spirits.* The effect of degree of temperature used—The use of water or steam—Surface action and its supposed effect—Processes in use—The utilisation of gases in solution to increase vapour tension—The steam engine *versus* the internal-combustion engine for motor traction—Conclusions.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEBRUARY 15...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Fothergill Lecture.) Professor Vivian B. Lewes, "Motor Fuels." (Lecture I.)

Victoria Institute, Central Hall, Westminster, S.W., 4.30 p.m. Rev. D. Gath Whitley, "Traces of a Religious Belief of Primeval Man."

Electrical Engineers, Institution of (Local Section), Mining Institute, Newcastle, 7.30 p.m. Discussion on "Wiring."

Surveyors' Institution, 12, Great George-street, S.W., 7 p.m. (Junior Meeting.) Mr. W. A. Kirby, "The Cultivation and Resources of the Huntingdonshire Fen Lands."

British Architects, Royal Institute of, 9, Conduit-street, W., 8 p.m. Mr. A. N. Prentice, "Architectural Sculpture in Spain."

East India Association, Caxton Hall, Westminster, 4 p.m. The Earl of Ronaldshay, "Impressions of India."

TUESDAY, FEBRUARY 16...Statistical Society, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 5 p.m. Dr. E. C. Snow, "On the Magnitude of the Population of England and Wales available for Emigration."

Illuminating Engineering Society, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. F. W. Thorpe, "The Development and Design of Lighting Fixtures in Relation to Architecture and Interior Decoration."

Royal Institution, Albemarle-street, W., 3 p.m. Professor C. S. Sherrington, "Muscle in the Service of Nerve." (Lecture IV.)

Engineers and Shipbuilders of Scotland, Institution of, Rankine Hall, Glasgow, 8 p.m.

WEDNESDAY, FEBRUARY 17...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. A. Wilcock, "The Decorative Textile Industries and the Designer's Relation thereto."

Meteorological Society, at the Surveyors' Institution, 12, Great George-street, S.W., 7.30 p.m. 1. Mr. A. E. M. Geddes, "Observations of the Upper Atmosphere at Aberdeen by means of Pilot Balloons." 2. Mr. V. G. Anderson, "The Influence of Weather Conditions upon the amounts of Nitric Acid and of Nitrous Acid in the Rainfall at Melbourne, Australia."

Microscopical Society, 20, Hanover-square, S.W., 8 p.m. Presidential Address by Professor G. Sims Woodhead, "Some of the Micro-biological Problems of the Present War."

Electrical Engineers, Institution of (Students' Section), Victoria-embankment, W.C., 7.45 p.m. Mr. A. Arnold, "Modern Power-house Condensing-Plant."

THURSDAY, FEBRUARY 18...Petroleum Technologists, Institution of, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. W. A. Hall, "The 'Cracking' of Oils, with a view to obtaining Motor Spirit and other Products."

Royal Society, Burlington House, W., 4.30 p.m.

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Linnean Society, Burlington House, W., 5 p.m. Mr. H. Wager, "The Action of Light upon Chlorophyll."

University of London, University College, W.C., 5.30 p.m. Monsieur C. Poupeye, "Belgian Art." (Lecture V.)

Chemical Society, Burlington House, W., 8.30 p.m. 1. Messrs. J. D. Canwood and W. E. S. Turner, "The dielectric constants of some organic solvents at their melting or boiling points." 2. Mr. F. D. Chattaway, "The preparation of allyl alcohol." 3. Mr. A. Parker, "The velocities of flame in mixtures of methane and air." (Part II.)

Royal Institution, Albemarle street, W., 3 p.m. Dr. P. Chalmers Mitchell, "Zoological Studies: War Evolution; Struggle of Species." (Lecture II.)

Camera Club, 17, John street, Adelphi, W.C., 8.30 p.m. Mr. C. E. Dawson, "The Photo-Play and its Possibilities."

Historical Society, 22, Russell-square, W.C., 5 p.m. Anniversary Meeting.

Numismatic Society, 22, Albemarle street, W., 6 p.m. Mr. H. Symonds, "The Irish Coinage of Henry VIII. and Edward VI."

Concrete Institute, 296, Vauxhall Bridge-road, S.W., 7.30 p.m. Mr. T. A. Watson, "Economy in Reinforced Concrete Construction."

Mining and Metallurgy, Institution of, at the Geological Society, Burlington House, W., 8 p.m.

FRIDAY, FEBRUARY 19...Royal Institution, Albemarle-street, W., 9 p.m. Professor H. E. Armstrong, "The Visit of the British Association to Australia."

Sanitary Institute, Manchester, 7 p.m. 1. Mr. S. S. Platt, "The Construction of Sewers." 2. Mr. H. Dryland, "Housing from a Sanitary Inspector's Standpoint."

Mechanical Engineers, Institution of, Storey's-gate, Westminster, S.W., 8 p.m. Mr. A. E. L. Chorlton, "Convertible Combustion Engines."

SATURDAY, FEBRUARY 20...Royal Institution, Albemarle-street, W., 3 p.m. Professor Sir J. J. Thomson, "Recent Researches on Atoms and Ions." (Lecture I.)

Journal of the Royal Society of Arts.

No. 3,248. VOL. LXIII.

FRIDAY, FEBRUARY 19, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 22nd, 8 p.m. (Fothergill Lecture.) PROFESSOR VIVIAN B. LEWES, F.I.C., F.C.S., "Motor Fuel." (Lecture II.)

WEDNESDAY, FEBRUARY 24th, 8 p.m. (Ordinary Meeting.) W. J. ASHLEY, M.A., M.Com., Ph.D., Professor of Commerce in the University of Birmingham, "The Economic Position of Germany." The RIGHT HON. SIR GEORGE HOUSTON REID, G.C.M.G., D.C.L., K.C., High Commissioner for the Commonwealth of Australia, will preside.

Further particulars of the Society's meetings will be found at the end of this number.

COUNCIL.

At the last meeting of the Council, on Monday, the 15th inst., the HON. RICHARD CLERE PARSONS, M.A., was elected a member of the Council and Vice-President of the Society, in place of the late Sir Owen Roberts, D.C.L., LL.D.

FOTHERGILL LECTURES.

On Monday evening, February 15th, PROFESSOR VIVIAN B. LEWES, F.I.C., delivered the first lecture of his course on "Motor Fuel."

The lectures will be published in the *Journal* during the summer recess.

CANTOR LECTURES.

The Cantor Lectures on "The History and Practice of the Art of Printing," by R. A. PEDDIE, Librarian of the St. Bride Foundation Typographical Library, have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Royal Society of Arts, John Street, Adelphi, London, W.C.

A full list of the Cantor and Howard Lectures which have been published separately, and are still on sale, can also be obtained on application.

COVERS FOR JOURNALS.

For the convenience of Fellows wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1*s*. 6*d*. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

A meeting of the Colonial Section was held on Tuesday, February 2nd, 1915; The RIGHT HON. LORD DESBOROUGH, K.C.V.O., and afterwards SIR THOMAS H. HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Chairman of the Council, in the chair.

THE CHAIRMAN, in opening the proceedings, said he very much regretted that he would be unable to occupy the chair after he had introduced the reader of the paper to the meeting, as the question of the Volunteer Defence Force, in which he was greatly interested, might be raised in the House of Lords, and he desired to be present. The author had written papers and delivered lectures on West Indian and cognate subjects. He was a delegate to the Agricultural Conference in Trinidad in 1912; was the West Indian Committee's representative at Ottawa during the Canadian-West Indian Reciprocity Conference in the same year; had been a West Indian delegate at three successive Triennial Congresses of the Chambers of Commerce of the Empire, and was engaged in the formation of an Association of Chambers of the West Indies. As those present might be aware, there was an Association of the Chambers of Commerce of the British Empire, which met every three years, the next meeting being due to be held at Ottawa in September, but in all probability, owing to the war, the meeting would be postponed for a year. That adjournment would give the author an opportunity of consolidating the

Chambers of Commerce in the West Indies, and enable him, as their representative, to speak with authority at the Congress whenever it was held. He hoped the Congress would apply itself, under the two mottoes of "Unity in Commerce" and "Unity in Defence," to the discussion of affairs of inter-Empire commerce in a practical manner, and that the results of those deliberations would be to the lasting benefit of the trade of the British Empire.

The chair was then vacated by LORD DESBOROUGH, and taken for the remainder of the meeting by SIR THOMAS HOLDICH.

The paper read was—

SUGAR AND THE WAR.

By EDWARD R. DAVSON.

Sugar is popularly considered to be one of the most domestic of articles, and yet it may be questioned whether any other product has been so much affected by politics and war. Certainly it cannot claim to have precipitated a war like tea at Boston in 1773, but it is the only commodity which doubled in price when the present war was declared, the only one for which a convention of European Powers exists, and the one selected by the Government to experiment with in State trading—a step which some may think one of the most interesting in the industrial history of this country.

It may be as well to refer to the position which sugar occupied in and after our last European war, viz., the Napoleonic struggles at the beginning of the nineteenth century, when commercial sugar was entirely produced from the sugar cane, and the West Indies and South America were responsible for supplying the greater part of the world's markets.

During that war a situation arose of which we have had a similar, though slighter, experience at the beginning of the present war. The enemy's ships—the "Emdens" of history—scoured the seas and sank many sugar-laden vessels, and as a beneficent Government had not then instituted a War Risk Insurance the loss fell entirely upon the sugar-planters. England, however, established her supremacy at Trafalgar in 1805, and the enemy's warships disappeared; but in 1806 a decree was issued from Berlin, which was then occupied by the French, that all trade communication with England was forbidden. This was known as the Continental system. It dealt a disastrous blow to the cane-sugar industry, but, as is ofttimes the case, the restriction of commerce recoiled upon its originator, and Napoleon found that the lack of sugar from which the French were suffering was most inconvenient.

Some years before this, however—in 1747—one Marggraf announced to the Royal Academy of Berlin that sugar could be made from beetroot, and in 1800 the King of Prussia started growing beet in Silesia in order to obtain sugar from it. This discovery seemed to Napoleon to afford him the solution to his trouble, and he also had a beet estate planted, and established four schools where sugar manufacture might be taught.

Thus began the great European beet industry, and also the rivalry between beet and cane sugar which has continued to the present day, and which, as I have shown, originated from war.

Germany gave large subsidies to beetroot, and therefore beet flourished and cane suffered. Then the Continental system was abolished, and once again cane flourished while beet suffered. Then slavery was abolished in the Colonies, and again the positions were reversed. Later on there began to grow up in Germany, Austria and France a development of the granting of subsidies in the system of Government bounties for the export of beet, which gave a tremendous impetus to the industry; so much so that, while in 1870 the production of beet was 952,000 tons, thirty-two years later—that is, in 1902—it had reached no less a figure than 6,180,000 tons.

The situation was a serious one for our colonial sugar industry. There could only have been one end—its extinction; and eventually the British Government realised this in 1902. So, thanks mainly to Mr. Chamberlain, at that time Colonial Secretary, this country informed the Powers that unless bounties were abolished she would prohibit the import of all sugar which received them. This resulted in the Brussels Convention, by which all the Powers agreed to abolish their bounties, except Russia, which came in later, in 1907, on special terms allowing the continuance of its bounties but restricting its exports; and from that time cane sugar was freed from this menace against its expansion.

This, then, was the position at the outbreak of the present war: beet sugar produced 8,910,000 tons, while cane sugar produced 9,610,000 tons, showing that cane had regained the supremacy in production which it had lost before 1902.

Most of the cane sugar, however, went to the Western world, and of the 1,970,000 tons which this country imported in 1913, 1,600,000 was

beet from Europe, and only 370,000 came from cane-growing countries. Of this 1,600,000 tons, 1,200,000 came from Germany and Austria, and therefore we arrive at the important fact that 75 per cent. of our Continental imports, or over 60 per cent. of our total imports, amounting in value to £15,000,000, came last year from the two countries with which we are at present at war.

Fourteen years ago I pointed out in an article in a review the large extent to which England was dependent on Germany for her sugar supply, and I further suggested that the German agricultural districts were looked on as the chief recruiting ground of the army, and that the bounties given so many years had possibly a military as well as a political significance.

You will find that General Bernhardi, in his book "Germany and the Next War," discusses this question of rural population, and states that while large sections of the population in the great cities are absolutely hostile to the army, "the country folk, from a military point of view, form the backbone of the nation."

Germany had a production of 2,738,000 tons and Austria one of 1,710,000 tons in 1913. Of this Germany exported 1,104,000 tons, of which 894,150 tons (or 81 per cent.) came to England, while Austria exported 1,056,000 tons, of which 324,000 tons (or 30 per cent.) were shipped to this country.

It is calculated from these figures that about 700,000 acres in Germany and Austria combined are devoted annually to the growing of beet for the English market, and that this industry must support not less than 350,000 men of serviceable age. One must not carry the argument too far, as these men, if not engaged in growing beet for us, would undoubtedly be doing something else. But one may be allowed to assume that by paying them this £15,000,000 annually we have been of great benefit to what Bernhardi calls "the backbone of the nation from a military point of view."

Now let us see what happened last August. Germany, Austria, Russia, France and Belgium, with a collective production of 7¼ million tons, or 40 per cent. of the world's sugar production, were at war. It was, therefore, assumed that there would be a shortage of this amount in the world's supply; but actually 4¾ million of this was produced for internal consumption, leaving 2½ million as the shortage to the outside world —that is, supposing that no sugar at all was exported. Latest statistics show that the shortage in Europe, in spite of the war, will be less than a million tons; but, as exports are largely curtailed, we may for our purposes put the deficiency to the outside world at two million tons. In 1911 a drought occurred in Europe, and there was a resultant shortage of this same amount of two million tons out of the world's production. On that occasion the price rose by 80 per cent. in England and America. In August last, therefore, the price might have been expected to rise to the same extent; but actually it rose by 140 per cent. On precedent, therefore, the price rose to an extravagant and unjustifiable height, and, as it was based on a false premiss, the presumption was that it would fall again. This has actually happened in America. Nevertheless the situation in August was a serious one; the retail price was rapidly advancing, and, considering the circumstances, there appeared to be great opportunity for wealthy speculators to try to effect a corner in sugar against this country.

The British Government thereupon decided to go into the sugar business. It proceeded to buy up a sufficient supply of sugar, amounting to nearly a million tons, to make certain of its wants for the ensuing six months, and it paid for this sugar, not the extravagant price of the moment, but a price approximating to the precedent of 1911. Once these supplies were obtained and England ceased to be a buyer in the world's markets, the reaction in price to which I have referred began. This reaction was aided by the fact that Austria commenced to offer some of its crop in outside markets. The result of this, in turn, was that cheaper sugars were offered in the English market, and the Government, presumably in order that it should not suffer through these cheaper and possibly enemy's sugars appearing in competition with its own, thereupon prohibited the importation of practically all sugar into this country except what it had already purchased.

Critics of the Government's policy have pointed to this fact, and have declared that the Government would have been wiser to have left the sugar market to take its natural course; but I do not think that one can offer any criticisms until the transaction is closed, and until it can be proved, if that is possible, by studying the psychological conditions and the possibilities of corners in August last, and by analysing the course of prices since then, whether the Government has been wise or otherwise.

There remains the larger question of whether a Government should ever undertake commercial

trading, but this does not come within the scope of this paper. Broadly speaking, however, one may say that the best safeguard against such a necessity lies in a wise provision which may prevent one from ever again becoming dependent for any necessary of life to the extent of 60 per cent. of one's wants on any foreign country or group of countries.

There is another point to which I would refer in this connection. The Government bought from Java and Cuba at a natural price--that is, a price fixed by the free bargaining of buyer and seller. With the British Colonies the procedure was different. The Government practically "commandeered" the sugar in these Colonies, and announced the price which it intended to pay. This price was not always equal to that paid to others, and it was undoubtedly lower than that at the time obtainable in the case of the West Indies by selling to Canada, and in the case of Mauritius by selling to India and this country. The Colonies made little demur; the nation wanted sugar, and they put patriotism before price and accepted what was offered. But this suggests an interesting thought. By "commandeering" the crops of the Colonial producers the Government has established the theory that producers of a commodity in the Colonies are liable to have that commodity taken over by the Mother Country in time of need. This is no bad theory, but it seems to require the corollary that to ensure such sources of supply in time of war we must not neglect them in time of peace.

There is still another point. The Government's action simply caused a displacement of sugar; it did not increase the sources of supply from which it could draw by one ton—that is to say, its solution of the problem was an emergency, and not a final one, for it consisted in taking other people's sugar and not in providing an increased supply.

Now in 1905 a Royal Commission was appointed with these terms of reference :—

"To enquire into the conditions affecting the importation of food and raw material into the United Kingdom in time of war, and to advise whether it is desirable to take any measure in addition to the maintenance of a strong fleet, by which such supplies can be better secured and violent fluctuations avoided."

The terms were wide, but the Commission confined itself for the most part to the consideration of the important question of wheat. Some of its findings, however, were interesting, as bearing on the subject we are considering to-day. For instance, it says :—

"In the Civil War of America supplies of cotton from the United States practically stopped. Other sources of supply were drawn on, but our total imports, which were 1,257,000,000 lbs. in 1861, fell in 1862 to 524,000,000 lbs."

That is to say, one foreign country supplied nearly 60 per cent. of our cotton, and when it went to war—although we were not concerned in this—we were cut off from its supply.

Again, the Commission says :—

"We regard the present variety of sources from which our supplies are drawn as likely to contribute to our advantage in time of war . . . Instead of deriving 62 per cent. of our total imports of wheat and flour from a single source, we are at the present time drawing our main supplies from four countries in widely different parts of the world."

Now this condemnation of our former dependence on 60 per cent. of our cotton and on 60 per cent. of our wheat and flour from a single foreign source is interesting, since, as I have shown, we are at present dependent on 60 per cent. of our sugar supply from what, as far as this war is concerned, we may call "a single foreign source," and I think we may fairly consider the remarks quoted as applying with equal force to sugar.

What, then, is the remedy to be? Surely that encouragement should be given to the growth of sugar within the Empire, not from any one source, but, as the Commission has it, from a variety of sources. It is true the Commission does not say that products should primarily be grown within the British Empire, but the friends of to-day may be the enemies of to-morrow. This war with Germany and Austria has meant the cutting off of 60 per cent. of our sugar supplies. War with Holland would mean the loss of Java as a source of supply. War with the United States might mean the cutting off of Cuba. We are told that we depend on our Fleet to maintain our food supply. This is true, as long as the supply is waiting to be shipped; but if foreign countries do not choose to sell us their products, no fleet can bring them to our shores. It is different with our Colonies. Their products are always at our hand, and the Government, as I have said, has claimed to have as much right to control the sugar of Demerara and Mauritius as the hayricks and horses of the British farmer. That is why I venture to say that our sugar supply should be primarily grown within the Empire.

Now let us see where these sources of supply may be looked for. There is, first of all, our own country. For some years past those interested in the agricultural development of our land have pointed out that in the flat lands of East Anglia we have a soil very similar to that on which the heaviest Dutch crops are grown, and they have argued that if sugar can be grown on such lands in other countries, there is no reason why it should not be grown on similar lands in England. Such an industry would supply work both for agricultural and factory hands, it would bring into beneficial cultivation lands now lying untilled, and it would improve the land which is already in cultivation.

In 1914 there were 341 beet factories in Germany, 209 in France, 294 in Russia, 201 in Austria-Hungary, 68 in Belgium, 39 in Italy, 32 in Spain, 27 in Holland, 21 in Sweden, 9 in Denmark, and also factories in Roumania, Bulgaria and other smaller countries. Yet in England, with its annual consumption of two million tons, there is only one small factory recently established at Cantley, in Norfolk, the establishment of which may be considered due to the agitation to which I have referred that beetroot should be grown in England. Actually it was erected by an Anglo-Dutch company, which placed its bonds on the English money market, and with part of the proceeds of these built the factory. Beetroot was planted in the neighbourhood by farmers, and as an import duty on sugar of 1*s.* 10*d.* per cwt. existed and still exists, the question of Excise immediately arose. The Government, however, recognised the need of giving encouragement to a new industry, and they have rightly, as I think, abstained from placing an Excise duty upon it, so that it receives a protection in the home market of the amount which I have named. Unfortunately, however, it cannot be said that the Cantley factory has so far proved as successful as was hoped. Difficulties have been experienced which I need not enter upon, but, broadly speaking, one may deduce this fact: A beet factory, to be worked successfully, must be worked on a large scale; the larger it is the more profitable it is, because the working costs per ton diminish, subject to the reservation that there is a certain distance beyond which it does not pay to transport the roots; but no capitalists are inclined to subscribe the capital and working costs of such a factory—say, £250,000 to handle 100,000 tons of roots—unless they are certain that these roots are going to be grown, and that the price of sugar will be sufficiently remunerative. On the other hand, no farmer is going to embark on a new industry and plant up many acres in beetroot unless he is assured that the factory is there to receive them, and is likely to continue to be there in the future, and that he also will receive a remunerative price. Therefore, one reaches an *impasse*, and it is suggested that it could be got over by the Government granting or guaranteeing whatever amount is required for the establishment of such a factory as I have indicated; and should such a factory prove the success anticipated, it is confidently hoped that other factories will spring up around the country, the capital for which would be subscribed from private sources. It may be said that a quarter of a million is a large sum for a Government to guarantee to a new industry, but such an outlay would be infinitesimal as compared with the extra cost of sugar in time of European drought or war (for in the three years 1904, 1911, and 1914 these have cost us over 20 million pounds), and it may well be regarded as a form of insurance.

Now let us look at our sources of supply within the Empire, of which the West Indies and British Guiana deserve pride of place, as being our oldest sugar-producing Colonies. In 1887 these Colonies produced 343,000 tons, which, with modern methods of manufacture, would represent about 450,000. Last year they produced 191,000 tons. Jamaica alone once produced 80,000 tons; it now produces 15,000 tons. The Windward and Leeward Islands in 1887 produced 45,000 tons, while last year they produced only 24,000. Now, why is there this serious falling-off in the production of the West Indies? One reason undoubtedly is that they have learnt to grow a variety of products instead of being entirely dependent on sugar. But this alone does not account for the diminution of the West Indian crops. It is largely due to the Continental bounty system to which I have referred, and when this system was abolished the predominance which the State-nurtured beet industry had established, owing to its scientific development and the considerable protection still left to it by the Convention, made it impossible for the cane industry, with its exiguous resources and injured credit, to recapture the markets and so restore the industry to its former size. So we find the West Indies dotted with derelict factories and sugar lands given over to catch crops, the restoration of which depends not

so much on the West Indian planter as on the British nation.

In discussing this subject one must refer to India—which has a normal production of 2,500,000 tons—that is, with Cuba, the largest sugar producing country in the world. India, however, is not likely to become an exporting country for many years, as, in spite of its large production, it imports about three quarters of a million tons.

A large part of this comes from Mauritius; and here, on the other hand, we find possibilities of an extension of the sugar industry. The present production of Mauritius is 225,000 tons, and there is at present a Government scheme of irrigation under consideration which, when carried through, will considerably extend the land available for cultivation. Difficulties exist over the matter, but prospects of a remunerative price for produce in the future would undoubtedly tend to smooth these away. Again, it cannot be said that the majority of the factories of Mauritius have got the most modern equipment of machinery, and here again, with the introduction of the latest scientific inventions, there is every likelihood that a considerably increased output could be obtained.

If we turn to the mainland of Africa, we find Cape Colony and Natal, in which a flourishing sugar industry already exists, and is capable of much development; but there is a growing demand for sugar in the country, and it may be presumed that as the sugar production of these Colonies increases it will be met by an increasing consumption, and, therefore, little reliance can be placed upon the possibilities of these countries supplying the wants of the British market.

On the other hand, we have West Africa and Southern Nigeria, the coastal parts of which are eminently suited for sugar-growing; and the same remark applies to British East Africa, where the low-lying front lands are similar to those of Demerara, and where vast crops could be grown if only the growers were assured of a market. Nor must we omit to mention Egypt, where the extensive irrigation works carried out both in Egypt and the Sudan make possible the further development of its sugar industry.

There are various other places within the Empire where sugar can also be grown or developed; but I think I have indicated enough to show that we could at any rate grow a considerable part of the commodity which we now import so largely from foreign countries; for be it remembered that the production for which we are looking for an alternative source of supply covers an annual acreage of a million acres, and if we regard the vast territories of our tropical Empire, much of which is still awaiting the hand of the cultivator, it does not seem that the proposition is a very large or a very difficult one.

But in order to accomplish this aim some encouragement must be given to Colonial growers, and they point to the fact that they are differentiated against in the English market, and that while the English beet industry receives a protection of 1*s.* 10*d.* per cwt., they have to pay duty of that amount.

By the terms of the Brussels Convention all signatory countries are allowed a protection on sugar imports of 2*s.* 6*d.* per cwt., or about ¼*d.* per lb., and this every country has availed itself of except Holland and ourselves. Supposing, then, that, as is probable, our duty continues, or is increased, I think that if for a term of years it was decided that it should not be imposed, not only on home but also on Colonial sugar, we should find a very large increase in the sugar production of the Empire. Remember that this is not a suggestion to increase the price, but only to waive the duty on a very small percentage. It is true that as the percentage grew there would be a continual decrease of revenue; but one may hope that there would also be a continually decreasing need for taxation, so that this country would not suffer.

It is true, too, that there is what one may consider rather an unfortunate clause in the Brussels Convention, that is—

> "The Government of Great Britain declares as an exceptional measure and reserving in principle entire liberty of action as regards the fiscal relations between the United Kingdom and its Colonies and possessions, that during the continuance of the Convention no preference will be granted in the United Kingdom to Colonial sugar as against sugar from the contracting States."

But considering the freedom of action which the Government has since claimed in respect of various matters connected with the Convention, and considering our present relations with some of the signatories, I think that the time has arrived—that is, if the Convention is not dissolved after the war—when this country should avail itself of this "liberty of action," and say to the world that its Empire is a single unit and that it can brook no foreign interference in domestic matters relating to itself and its Colonies.

But while giving to producers the opportunity of a remunerative price, on which I have touched, there is also the need of guaranteeing that opportunity for a definite period of time.

During the Canada-West Indian Reciprocity Conference in Ottawa in 1912, I could not help being impressed by the way in which both parties realised that a preferential tariff was not in itself sufficient to develop trade, but that this tariff must hold good for a sufficient time to allow capital to be invested with security in the trades and industries which it was desired to develop.

Hence the signing of an agreement by which Canada and the West Indies gave a preferential tariff to each other for a term of ten years, and incidentally one may note that the West Indies, dependent as they were on their tariff for revenue and small as their exchequers were, also gave a preferential duty on English goods for this period.

These measures, then, the absence of Excise on and State encouragement to home-grown beet and the waiving of duty on Colonial sugar, for the same term as some of the Colonies have given us a preference over Germany on our manufactures would, I believe, bring about the desired result. And let me point out that such a consummation would also mean the extension of the British sugar-refining industry. For of the 1,600,000 tons last year imported into England, 928,000 tons were refined sugar; and there is no reason why a large portion of this should not be refined in this country.

What, then, is actually being done? Nothing, I am afraid.

It is true that the Board of Trade has recently started a campaign to capture German trade, and Chambers of Commerce have taken up the matter with commendable zeal; but so far there is little sign of one of the most important items of the propaganda receiving the study it deserves. It is true, too, that a Royal Commission on Sugar Supplies was appointed in August to deal with the State purchases of sugar to which I have referred, and its terms of reference include these: "To inquire into the supply of sugar in the United Kingdom . . . and generally to take such steps as may seem desirable for maintaining the supply."

But I do not think it is meant to extend its scope to a question of such Imperial importance. If official investigation is necessary to inquire into these matters, I venture to suggest that a reappointment, even to a limited extent, of the Royal Commission of 1905 on Food Stuffs in time of War would carry weight and probably achieve a beneficial result.

Political economy in the past has concerned itself mainly with the rival benefits or drawbacks of Free Trade and Protection in reference to international trading. I think, however, that there must now be added to these two theories of trade a third one in the need of preserving our food supplies in time of war; and surely this war problem is a far greater and a far more urgent one than any problems of peace; for in peace time the difference between a right and a wrong course of action in trade will certainly mean a difference in the amount of wealth which may be obtained, but in war time this difference may mean the starving out of this country and the extinction of the Empire.

Already the old order changeth, and Governments of whatever party they may be are showing a greater sympathy with the need of assisting commerce. We are beginning to recognise, as Germany has long recognised, that trade is a part of the fighting machine to be jealously fostered and safeguarded by the nation, and only less important than the fighting forces themselves. Therefore, one may hope that this question may be treated, not so much in accordance with the rules of text-books and traditions and creeds, as in accordance with the needs of this country which emergency calls forth.

In conclusion, let us remember that our Colonies will surely say this to us: "For years past you have paid these millions of money for a product which we could grow as well to those who are now your enemies. For years past you have thus helped to fill their war chests and supply their armies. And now, when they make war against you, we let you seize our crops, we give you what we can in money and in kind, and we send you our sons to fight against a common foe. What is to happen after the war? Are you going to let the unity of the Empire be a reality for us, or are you going to give your custom again to our enemies, and so once more help them to prosperity at our expense?"

That is the question which they will surely ask, and I hope that in reply a prompt and satisfactory decision may be reached; and if by this decision such remedies as those which I have ventured to indicate to-day can be adopted, I think we shall find that, in increasing the sources of our sugar supply, we shall be increasing the prosperity of our kith and kin abroad, and that by protecting our producers in time of peace we shall be protecting our consumers in time of war.

DISCUSSION.

Mr. C. Sandbach Parker, in opening the discussion, said the subject of the paper was of particular interest to him, as during the whole of his business life he had been engaged in the production of sugar in the West Indies, and for the last twenty years he had devoted the closest possible study to the conditions affecting the production of sugar all over the world. The question before the country at the present time was whether the policy that had been adopted in the past was a wise one in its own interests, and if it was not whether it was prepared to alter it. It seemed to him that anybody who had read the Report of the Royal Commission on Food Supplies, and who had noticed the effect of the cutting off of a large proportion of this country's supplies by the war, must be struck by the fact that in the effort to support what had justly been called a fetish, *i.e.*, to allow trade to pursue absolutely its own course, the country had got into a position where, unless the Government had stepped in to protect the sugar consumer, it might have been face to face with the most severe famine of sugar that had ever been known in the history of the world. The people who were most interested at the present juncture, in considering the question in all its aspects, were those who relied upon sugar as a raw material for their industries in this country, such as the refining industry, the confectionery industry, and numerous other sugar-using industries. It was for them to make up their minds whether they were prepared to see the country go back to the old position of practically entire dependence on foreign supplies, or whether they desired that some effort should be made to make this country less dependent for its supplies on foreign sources, especially when they knew perfectly well that the sugar which was required for this country could be produced within the Empire, given security of market, as cheaply as it was produced anywhere in the world at the present time. Some people might say that the West Indies could not produce all the sugar that was required, but those were not the only Colonies in which it was possible to grow sugar. The author and himself were proud of their connection with the West Indies during the most troublous years of their history, and he hoped they had gone through the worst times, so far as the sugar industry in those Colonies was concerned, that would ever occur; they looked forward to better times. Whereas years ago the common complaint of the sugar-using industries was that the West Indies wanted protection, and that it would pay this country better to give them a big bounty, or pay them so much a year, than to go on buying its sugar abroad, the position was totally different at the present time. There was now a safe market for West Indian sugar owing to the arrangement to which the author had referred that had been made with Canada, and, having that market secure, as West Indians they were not so dependent on the English market. Therefore it was for the consumers in this market to make up their minds whether they wished to develop the industry of the British Empire, and if so what steps they were prepared to take to bring it about. The author had proposed a remedy practically on the same lines as the one proposed by himself in an article he wrote on the subject two months ago, namely, a differential tariff. He believed the time had come when the consumers of this country, both those who eat the sugar and those who used it in producing some other product, would see that it was to their interest to promote the production of sugar within the Empire. Negotiations had recently taken place between the Government and the people interested in the aniline dye industry with the object of producing in this country the dyes which had mainly been obtained from Germany. The Government offered to lend so much money towards the establishment of the industry, but the manufacturers argued that they would eventually be exposed to the same dangers and troubles that the sugar-planters had experienced in the last forty years in the West Indies, namely, that the producers of the articles on the Continent having a highly-protected market in which they were absolutely secure were able to produce the article in large quantities and to ship the surplus to other countries. As the result of those negotiations the Government had now offered, he believed, a large loan for a period of twenty-five years at a low rate of interest, which was very much equivalent to the proposal the author had made, which he (Mr. Parker) supported. This war was equivalent to giving tariff assistance to the industry in this country for the purpose of preventing it from being drowned, suffocated and strangled by unfair foreign competition; and that was all that was required to produce a large development of the sugar industry in the British Dominions. Unless some security of market was guaranteed for a considerable number of years it was impossible to go to capitalists and ask them to invest probably twenty-five millions in erecting the factories, etc., necessary in the British Empire to produce the sugar required in this country. It seemed to him it would pay this country to adopt the principle suggested by himself and the author. It was no longer a question of helping a comparatively small industry, as it had been in the past, but of providing a cheap and steady supply of raw material not only in war time but in time of peace; and by increasing the area from which the supplies were drawn a more stable price would be maintained, which would not be liable to such great fluctuations as had occurred in the past. He was recently told that West Indians ought to have been contented with the fact that the Brussels Convention had abolished bounties. While that was perfectly true, it had not created free trade, because the British Empire could not send its sugar to foreign countries, while foreign countries could send their produce to England, charging what they liked for the article in their own country and sending the surplus here. It would be to the true interests of this country to offer such inducements to capitalists

that the most modern factories could be put up in the Colonies. An unfortunate impression had got abroad that there was antipathy and competition between British Colonial growers of cane sugar and home growers of beet sugar. That impression ought to be stamped out, if it existed. There was plenty of room for both, and the Colonies had no right to ask that this country should not develop its beet industry if it wished to do so. As a matter of fact, they welcomed the promotion of the beet industry in the interests of this country, and at the same time this country ought to welcome the production by its own Dominions overseas of such sugar as it could not produce itself. He hoped nothing more would be heard of any criticism of the Government for endeavouring to establish an industry which many people, himself included, believed would in the future be a very valuable additional agricultural industry in the country.

MR. W. T. CHADWIN (Secretary, British Sugar Beet Council) said the people of this country had had brought home to them through the war the reality of the dearness of sugar. The country depended for one of the necessities of life absolutely on outside sources. As this country was by far the largest consumer in Europe it ought to produce a certain amount of the sugar it required, but that it could produce the whole of it, as some people imagined, was quite a fallacy. It would never be able to produce two million tons of sugar a year without such a disturbance of other agricultural industries as would make it impossible of achievement. It was quite likely, however, that half a million tons could be produced in the country, and that would tend to check the wild speculations which took place when reports were circulated of the shortage of the crops of the world from various causes. The author had stated that an additional 700,000 acres within the Empire ought to be cultivated in order to meet this country's sugar requirements. Personally he had made a study of the beet-sugar industry, not only of this country but of the world, and he thought he was right in saying that, under normal conditions, at the present time the annual increase of the world's requirements in regard to sugar meant the produce of something like half a million additional acres every year to the preceding year's sugar crop. There was, therefore, no question of any competition between cane and beet, there being ample room for both. The one question that had to be discussed at the present moment was how this country was to secure such a position that the necessary capital could be found for establishing the industry. The sugar industry could not be started without a relatively very large capital. In some cases it was necessary to combine the growing of sugar beet and the manufacture of sugar, and that combination meant the employment of a larger amount of capital; but unless capitalists had some sort of security of a permanent nature it was hardly likely they would find the necessary money. It seemed to him that the means foreshadowed by the author met the case admirably. Personally he did not think it would be a hardship to the consuming population if a duty equivalent to ½*d.* per lb. were imposed on sugar. Sugar had been so ridiculously cheap that it had led to enormous waste taking place, and ½*d.* per lb. would permit of a good deal of elastic differentiation between this country, the Colonies and the rest of the sugar-producing part of the world, quite sufficient to protect the industry, both in this country and in the Colonies, and to allow of the necessary capital being put into the undertaking.

MR. J. J. EASTICK, F.C.S., M.S.C.I., said that the war seemed to have brought about the unity that was necessary amongst all the sections of the population who wished to produce sugar within the Empire. He had noticed of late there was a tendency on the part of those who had been advocating the policy of the growing of beet in England not to be selfish, but to reciprocate and offer the same protection that they desired to those who grew cane sugar. Those who had been long interested in the cane-sugar industry were also advocating that there should be a similar measure of protection to the home-grown beet as they had been asking for the Colonial-grown sugar. If the home and Colonial growers, and also the manufacturers who used sugar, could all be united, he had not the slightest doubt that the British community would gladly assist in granting a measure of protection from the unfair methods that had been adopted by Germany and Austria in building up their gigantic industry, which the English people had been foolish enough to allow the Germans and Austrians to do to the detriment of the Colonies. He was greatly in favour of producing the food required for the Empire within the Empire. He had now no axe to grind, as he was entirely out of the sugar trade, with which he was connected for thirty years; but he remembered writing in December, 1908, to the English Government telling them that he intended to start a sugar industry in England in which beetroot would be utilised. He received a reply to the effect that no duty was at present payable on beetroots grown for sugar in England, but that if works were started there was not the slightest doubt that an Excise duty would be levied. As under those circumstances he would have no defence against any action that Germany or Austria might take, he refused to build the works. Since then a works had been started, and although he was exceedingly glad to see that an experiment had been tried, he did not like to discuss that works because, to his mind, it was chiefly German and Dutch, and not English. He doubted whether it would be a success, not because sugar beet could not be grown in this country, for he was firmly convinced it could; but it was hardly possible to call an industry a British industry when a large number of old beet factories on the Continent, which represented more than three-

quarters of the capital that was required, was tacked on to a new industry. One good thing it had done was that it had introduced the thin end of the wedge, because the Government had felt they could not levy an Excise duty, although they had repeatedly said they would, so that this country could now defend itself against the unfair actions of its Continental enemies. It had been said that the Brussels Convention abolished State bounties. It was not the State bounties that were unfair—they were open and above board. There was another more insidious weapon than that, namely, the cartel system. Back in the early eighties he was sent to Magdeburg to investigate the question, and found they had an accumulated fund of five millions sterling to fight English and Colonial refiners. There was a surtax of £10 a ton on the Continent, so that the cartel could charge the home consumers whatever they liked up to that amount, and could utilise the fund thus accumulated to attack this country, and there was no doubt their object was absolutely to annihilate the British sugar industry. The surtax had been reduced to £2 10*s*., which could still be used to build up a fighting fund to fight this country. Unless some measure of defence was adopted, this country would still be at the mercy of Germany and Austria through the cartel system, which was far more important than the State bounties. The people of this country must not lose sight of the necessity of getting the surtax of £2 10*s*. abolished. The manufacturers in England were rather opposing any measure of defence or protective duty, but if the area from which sugar was produced was increased by giving encouragement to the Colonies to expand, that would have the effect of keeping prices down. Manufacturers were adopting a selfish policy in refusing that measure of defence which was necessary if the sugar industry of the Empire was to be increased, because capitalists would not embark their money in a concern unless some security was given to them. It must also be borne in mind that a large amount of sugar was being accumulated at the present time in Germany and Austria. The German Government had passed a Bill under which they had advanced money, on mortgage, on two million tons of sugar which had been stored, and which they hoped to dump on to the British markets after the war, and our Colonies would thereby suffer.

Sir Thomas Holdich said that, in a discussion which was not only commercial but technical and somewhat political, he could offer no useful suggestions, and he therefore merely asked the audience to join in passing a cordial vote of thanks to the author for his excellent and logical paper. It seemed to him that the author had entirely succeeded in proving his point. He desired to ask only one question in reference to the restoration of sugar cultivation in the West Indies. It would be remembered that the author had referred to the catch crops which were grown in the West Indies in lieu of sugar. Those catch crops appeared to him, when he was there not very long ago, to consist very largely of bananas, and on questioning the agriculturists there as to whether the banana crop or the sugar crop was the more productive and useful financially, they all plumped for the banana. He would therefore like to know whether the sugar cultivation in the West Indies could be reorganised so long as bananas proved to be so very productive and useful financially.

Mr. Byron Brenan, C.M.G., seconded the motion, which was carried unanimously.

Mr. E. R. Davson, after thanking the audience for the very kind manner in which his paper had been received, and for the vote of thanks that had been accorded to him, in replying to the point raised by Sir Thomas Holdich, said there were many districts in the West Indies where other crops than sugar had been grown, and there could be no doubt that the growing of bananas was one of the most paying industries of the Colony. He was afraid, however, there were other parts of the West Indies where sugar used to be grown, and where little was grown at the present time. One of the most depressing sights in the West Indies was to see acres of land lying fallow which used to produce sugar crops, and old sugar factories covered with creepers and tropical plants. That was a result primarily of the European bounty system. In conclusion, he desired, in the name of the audience, to thank both Lord Desborough and Sir Thomas Holdich for having presided over the meeting.

The Earl of Denbigh, C.V.O., writes:—I much regret that owing to my being quartered at present in Norfolk I only received yesterday your letter of January 27th, telling me of Mr. Davson's paper. So far, there has been much talk, and nothing but talk, and if only the Government would take a large view of the question, and either put up a good factory themselves or else declare, as a question of policy, that free German and Austrian sugar imports would not be permitted after the war—at all events, for a stated period of years—in order to attract capital and private enterprise, something might then be done. It is now purely a question of getting the support of that difficult and conservative person, the British farmer. Pay him such a price for a period of years as will make the growing of beet a really profitable thing, and you will get the raw material for several factories. The price which the factory can pay for beet is dependent on the price obtained for the finished article and on the cost of working. The latter is certain to decrease year by year as the industry, and especially the labour, becomes more and more organised and understood. In all probability after a few seasons the confidence of farmers will be more established, and they will realise, apart from the cash sales of roots, the benefit derived from beet cultivation as shown by improved succeeding crops.

They would probably therefore then be more willing to accept a lower cash price if sugar should again become cheap in the world. Against Government putting up factories there are many objections, for Governments do not often make a success of industrial concerns. Granting subsidies to factories is only another name for the much-abused system of bounties. Relax the strict principles of Free Trade for a term of years, as both such strict Free Trade purists as Lords Rosebery and Cromer are recommending in support of the dye industry, and the private capitalist comes in, and the industry goes ahead automatically. It is exasperating to see such an opportunity as the present slipping away.

TENTH ORDINARY MEETING.

Wednesday, February 17th, 1915; Sir Charles Waldstein, Litt.D., Ph.D., late Director of the Fitzwilliam Museum and Slade Professor of Fine Arts, Cambridge, in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Horn, Wilbur F., M.A., Carlisle, Pennsylvania, U.S.A.

Mayeda, T., Shimboricho, Shiba, Tokyo, Japan.

Myers, Fred L., Kingston, Jamaica, British West Indies.

Salur, Raja of, Fort, Salur, Vizagapatam District, Madras, India.

The following candidates were balloted for and duly elected Fellows of the Society:—

Buckland, James, 28, St. Thomas's-mansions, Westminster Bridge, S.E.

Khan, Choudhri Md. Aziz-ulla, Sahawar, Etawah, U.P., India.

The paper read was—

THE DECORATIVE TEXTILE INDUSTRIES AND THE DESIGNER'S RELATION THERETO.

By Arthur Wilcock.

It is now some twenty-five years since I received from this Society a prize for Decorative Textile Design. I was then a youngster relying entirely upon my individual effort, and the encouragement I received from so unexpected a recompense was all the more valued, coming, as it did, from a society so well qualified to pass a judgment.

The two designs that brought me this honour were those exhibited at the Arts and Crafts Society of 1889, both for printed cotton. It was at a time when my connection with trade and industry as a free lance was just beginning. One of these designs was produced, but I am sorry to say proved an utter failure. The producer assured me that, after all the expense he had incurred, the engraving of copper rollers, and the printing, he had not sold a yard of it. Why was this? Could I rail against the public for not buying a yard of what the Royal Society of Arts thought so worthy? No. Evidently the public had found something wrong with it. So I and my producer put our heads together to discover what had caused this pattern's ruthless rejection. After considering a full length of the printed cloth for some time, he said to me: "I know. Don't you see it?" I said, "See what?" "Why," he said, "the movement. It's all on the go, my boy." "Well," I said; "it was that waving effect I wanted to realise. I call it 'Waving corn and poppies,' you know." "Well," he said, "whatever you call it, or whatever the effect you wanted to get, it doesn't sell! So don't come here again with any more designs that are 'all on the go.' The public don't like 'goey' effects on their chairs and curtains." I went away crestfallen, for my artistic soul was in that waving corn! Since that time onwards I have learnt, and am still learning, many things the public don't like and do like.

I need not point you so obvious a moral which bears so directly on my subject.

My reason for attempting this paper is to place before you, as well as I am able, some facts concerning the decorative textile industries and the conditions of trade which govern their production, and especially to bring forward the limitations of the designer, upon whom these industries depend for novelty in design; to consider the advisability of aiming at a higher efficiency in the art worker, and to suggest what means, if any, can be adopted towards the more effective employment of the student.

Under decorative textiles I include woven silk damask, brocade, wool and cotton tapestry, damask linen, muslin, hand and machine printed cotton and linen, and wallpaper. The last-named can hardly be defined as a textile, in the ordinary acceptation of the term, although in its pattern and texture it is frequently an imitation of the woven textile. I include it, however, as one making a great demand upon the resources of the designer.

The various industries I have named, one would think, give ample scope for the employment of many skilled hands and much intelligent creative effort.

I have brought together a few of these decorative textiles which have been made for the furnishing and decorating trades as examples of recent production, not to ask your admiration nor to invite your criticism, but as representing designs which have received the approbation of that elusive phenomenon we call the public. In making a selection from the examples kindly placed at my disposal by various firms supplying these textiles, I have made a special point of selecting those which have had a more than usual commercial success.

It would be the merest platitude for me to tell you that the existence of an industry is maintained by the public, but I am afraid that our Art educationalists need to be constantly reminded of this vital truth in order to prevent their laudable enthusiasm for Art from obscuring the practical aim and end of production. However lofty our ideals may be, when translated into textiles they have to be sold at so much a yard if the artist and the various workers employed in that industry are to have the wherewithal to live.

Undoubtedly the best periods of textile design are those of the twelfth to the sixteenth century. The early Sicilo-Saracenic silks still appeal to the student of design for their beauty and simplicity, and I venture to think you would agree that the enormous creation of pattern from that time forward through the succeeding centuries, and through the various phases of fashion, would meet the needs of the most exacting taste of the present day. But since the character of a nation finds expression in its Art, we designers, instead of reproducing these bygone styles, must go on creating for the needs and taste of our own time--biased, it may be, in these days of commercial enterprise, by other motives than those that influenced the mediæval artist. Ours may be a more self-conscious Art, but it is an Art nevertheless that will leave its mark on the history of our time, whether for good or ill.

As in all periods, the best only is likely to survive for a later generation. I venture to say that among the best of our present-day productions many may be found of sufficient excellence to deserve a place in posterity, even though they may be created by the trade designer as distinguished from the designer with a mission, or, shall I say, who can afford to be independent of existing trade conditions. Such a one was William Morris. In him we had the producer as well as the designer—a fact too often lost sight of by those who complain of the dearth of originality in decorative art. And I make bold to say, that, giving the trade designer the same opportunity and means, we can to-day produce for the world many artists of the same ability.

Imagine, if you can, such a man as Morris, without any of his other great gifts, entirely dependent on the caprice of trade and without other means of livelihood, and you will appreciate that his fine work would have been entirely lost to the world. The designer is no exception to the law of opportunity.

Style in Design.

On this subject of style in design for textiles generally, we must assuredly be guided by our technical medium. Our sense of fitness must control us apart from other considerations. One can be gayer and more playful on one material, sober and more dignified on another. The gossamer texture of the muslin, for instance, calls for a lighter fancy than the treatment adopted for a heavy silk, which in its turn would demand a more stately ornamentation.

The wallpaper stands by itself as a decorative material, more dependent upon design than any other, because of its poor fabric. The textures of silks, velvet, tapestry and canvas are all in turn imitated on this material with a wonderful ingenuity and fidelity. It is of all decorative fabrics the most sophisticated. One cannot be guided here by the technical medium; in fact, the designer is required by the producer to forget the paper and aim at a treatment that will disguise its flat, uncompromising surface. At all events, such treatments are generally found to be the most successful in this trade.

In the printed cotton and linen the design is no integral part of the textile—that is to say, not woven. Delicacy and refinement in the design would naturally direct the judgment of the printer to a finely-woven cloth, whereas a broad and bold treatment of design calls for a coarser cloth.

Now, as regards the style of pattern mostly favoured by the public; those of you who have been acquainted with my work for cotton prints and wallpaper know that I have persisted in using a somewhat real rendering of natural flowers in my designs. I love natural flowers, and the public love natural flowers, and I suppose this is one of the reasons why I have been considered a "trade" designer. How much there is in this love of the æsthetic and how much of the business instinct, I will leave to your gentle tolerance. I must own, however,

to an interested affection for the necessities of life, and my first master of design must be blamed for this; for it was he who turned my young and guileless footsteps towards the sordid path of breadwinning. "A designer," he used to say, "who can do this natural style *well* will never be in need."

Since those days I have proved the wisdom of his statement, for, among other things, I have found few competitors in England contesting this most difficult of all styles. It is a style, moreover, that will accord with the decoration of most rooms of the average house. I, and my friend the public, welcome in the home the bright colours and the gay abandon of natural flowers not too far removed in their rendering to recall the beauty and the sweet perfumes of the garden.

Some who think I am violating an established canon of Art may agree with me that it is fortunate a restricted technical process of the printer compels all the convention necessary to make the design in every way acceptable as decoration for the fabric intended. In further defence, if any is needed, I am, as regards the cotton print, following on traditional lines established in England in late Stuart times, evolved from those first importations of Chinese porcelain and wallpapers in which you will find this natural rendering of flowers. This style has run through the Queen Anne and Georgian periods, variously influenced, until we arrive at the much-abused early Victorian period, when those very clever block-printed chintzes of Swainson and Dennys and Clarkson were produced. These are considered to this day by the better-class decorators of the highest decorative value, especially in the furnishing of the country house.

Technical.

It is not my intention, nor have I the time at my disposal, to demonstrate, even in a cursory manner, the various technical processes in each of the industries producing decorative textiles, but as an example of rapid production there is one in particular to which, in passing, I should like to refer you, viz., the machine-printed cotton.

In its manufacture (as in the manufacture of wallpapers) we have a huge cylinder machine, the large central drum (or bowl) revolving with the plain cloth against as many engraved copper rollers as there are colours in the design to be printed; these engraved rollers have each its own colour trough, in which revolves a felt roller feeding the printing roller with colour. The printing roller is immediately scraped clean by a sharp knife running the full length of the roller, thus leaving only the incised parts charged with colour (or thickened dyestuff and mordant). This impresses the plain cloth on the central drum with every atom of colour that remains in its most delicate incision. The printed cloth is then run into a steam chamber, which discharges the thickening matter, renders active the mordant, and fixes the dyestuff. It is then washed, and, after a finishing process, is ready for the market.

A twelve-roller machine can run off about three miles of printed cotton in two hours. It may be of interest to some to know that in this process, before the pattern has been consumed by the public to the extent of 10,000 yards, it has not brought sufficient return to the producer to compensate him for his outlay. So that when we speak of a design as commercially successful, it has had to be produced in enough quantity to drape, for example, all the windows on both sides of the Strand.

The printing-machine will cost somewhere about £2,000.

Now the hand block-printed cotton and linen are far less exacting as a paying concern in their demand for consumption, selling as they do at something like six to ten times the price of the machine-printed article, and the printing blocks rarely costing more than from £40 to £100, from which any length can be printed according to demand.

The characteristics of the block-print are its directness of method and its solid yet soft colour effects, not so mechanically even as the machine production and, like all handwork, it has a charm of its own unapproachable by any machine process.

The printed cotton has been in enormous demand of late, consequently the designer has received, year by year, much consideration from that industry. Any fabric in which pattern is so insistent on the attention must tire more quickly than one less insistent. The designs, therefore, for printed cotton and wallpaper have a shorter life, and are more in demand than, for instance, those for silk and linen damask, or any monotone effect. Indeed, the work of the designer would be almost gone should such be the only textiles used by the decorator.

Cheap production made possible by the large productive power of the machine, has only added to a more frequent demand for change.

In designing for the machine-printed cotton,

the designer has fewer technical limitations than for any other process. His most sensitive line can be produced by the engraver on copper with absolute fidelity, and if he takes full advantage of the process a twelve-roller machine will give him a palette sufficient for any colour effect desirable in purely decorative work.

In the case of the textile that receives its decoration from the warp and weft of the loom, the designer has greater limitations. Such effects as one is tempted to obtain in the print with a process so generous are quite impossible in a process with greater limitations.

Of all woven decorative textiles the silk brocade is the richest, and may become in the hands of a skilled designer a beautiful and rare contribution to industry. The lesser cotton decorative textiles are muslin and lace used for draping windows. The former is known in the trade as Madras muslin. It is of delightfully soft texture and of the simplest possible structure, consisting of a light ground net, on which is run a heavy cotton weft. That which decorates the fabric is caught down by the ground net, and that not so tied is cut away from the fabric in an after-process consisting of running over the surface with rapidly-revolving knives, similar to a lawn-mowing machine.

New processes are introduced from time to time in the textile industries, which it is necessary for the designer to understand; but the designer, working independently of the factory, is one on whom the industries rely rather for artistic than technical advice. The artist comes first, technicalities of a process come next, the designer not slavishly following, but rather leading to the limit of technical possibilities. He should be only sufficiently well acquainted with them as to be on nodding terms; not too familiar, lest they corrupt and degrade him. He is most effective as a designer when producing a maximum effect with a minimum of means. He must be able to think in those means. Just as fluent speech in a foreign language is impossible without thinking in it, so the artist's expression in the restricted language of industry will proclaim him eloquent or halting.

It is sometimes possible through this language to make the personality of the designer felt. Efforts have been made towards the better recognition of this personality of the individual designer and craftsman. The Arts and Crafts Exhibition Society is one of these. Its aims and ideals are excellent as affecting the hand-craftsman, and much good has doubtless been done by bringing him directly in touch with his public. But the public who appreciate the personal work of the designer and craftsman and who will buy the expensive handmade article is, I may remind you, an extremely limited one. The machine with its enormous productive power, its gigantic economic interests, and its complex and expensive distributing agencies, has not been sufficiently recognised. The machine industry supplies an immensely larger public, who are for the most part, if not wholly, indifferent to the personality of the artist and will listen to no language at all cryptic or symbolic.

To such a public we designers are asked to proclaim our artistic souls, to educate and elevate taste. Can one imagine a feebler medium of speech than is afforded by the textile? In some of those beautiful Persian silks of the twelfth and thirteenth centuries you will find Arabic inscriptions from the "Koran" very cleverly incorporated into the design. I wonder sometimes if the modern designer's educative mission would be served by some such *motif*. A text of Scripture or a little Ruskin? No. I think I know the public well enough to say it does not like to be talked at from its wallpaper or curtains. It rests content with something pleasing in colour and design. To trouble about the designer himself, however personal his manner, is as far removed from its thoughts as the maker of its butter.

The designer, therefore, is one who takes his place with the other impersonal units that go to make up a great organisation; any hope, therefore, of recognition by the public is out of the question.

Conditions of Trade.

Under the present conditions of trade the most the designer can expect is that he may be recognised by his fellow-designers and a few experts in the trade. He may also expect, as a foregone conclusion, that on the issue of any commercially successful textile by his producer, the competitors of that producer will ferret the designer out of his obscurity. This, then, is the only reward of successful expression.

If the artist's egoism is gratified by such recognition, he is well on the way to becoming a trade designer, especially if he has the means at command, and is willing to increase his output by attracting to himself other workers to assist him in supplying a larger demand.

A very elementary condition of trade connected with art industries producing pattern

design is the desire to capture trade by novelty. Indeed, the essence of all trade is the creation of demand, the making of things to-day that shall make yesterday's things seem old and out of date—the hazard of speculation on a prospective want. What wonder, then, that the man with ideals, failing to grasp this simple condition, has fallen out by the way and has become the malcontent or the revolutionary? What wonder that our Government design student, brought up and nurtured on the pure milk of classic art, finds he is not wanted? Moreover, the trades dependent on novelty in design do not want (for long) the man whose expression of art is restricted to one form, however good it may be. They want a man of the world, a man with his finger on the pulse of public taste, who will lend himself to trade enterprise, where, as an artist and man of discriminating judgment, he can seize on the salient features of any passing phase. By man of the world, I mean a man in touch with the world's movement, as my learned Chairman so well put it in his lecture here last year on "Fashion in Art and Art-Industry," when he said, in speaking of the designer: "He should not only know the past but he should be responsive to the expression of his age in every form, and the wants and needs and preferences of the society in which he lives, and for the tastes of which he is to cater. In one word, I maintain that the most efficient designer for our art industries, besides being a master of his immediate craft in design, should also be a man of the world, educated to perceive and understand the life about him in its most advanced, delicate and refined manifestations." Such a definition is, if he will allow me to say so, perfect in its completeness. But as a trade designer I would just like to add that to bring these qualities to a practical issue he must have the ability to impart his ideas to others, to those hands best suited by their peculiar ability to express them in the making of designs sufficiently varied to meet the demands of industries that call insistently for variety, not only of style but of interpretation, or shall I say "handwriting"?

My own experience leads me to believe that a great factor in the creation of fashion is the ability of the designer and producer, when once a demand is felt, to supply that demand and to press it home to the public in such quantity that it must in the end gain a fuller and wider attention. Here is trade risk. Quantity must be there, and if one considers what an enormous world enterprise trade is, both producer and designer must have large resources of production, or the demand will pass out of their hands into those more capable of dealing with it.

It will be readily understood that this production of quantity leads to over-supply. It also "gives one furiously to think" that the designer lives largely on that over-supply.

If, therefore, there is an over-supply of designers living on industries that are over-producing themselves, it will to some extent explain the present desperate struggle for life of the designer and the low morality in trade, which comes near to dishonesty, on the question of design copyright.

Mechanical science has enabled industry to give us a technically perfect product at a low price, but at what a cost, if uncontrolled by some better organisation of supply!

Again, another condition the designer has to contend against in trade is the modern tendency towards the limited liability company, which tends to eliminate the personal element. The departmental head—the buyer of designs—is not always, or, I might say, is rarely a man of great attainment—more rarely still is he endowed with sufficient knowledge of art to appreciate original effort on contrasting lines of style. He works on what he considers "safe" lines, which are always analogous. With a wonderful memory for patterns of his own and his competitors which have been commercially successful, he plunges more deeply into the mire of competition. We get, therefore, a greater sameness and an enormous over-production on one style. All are following, and very few have the courage to lead. Until, therefore, the selection of design reverts again to the more educated individual, not of less, but of more, business capacity, the call on the imagination of the designer will remain restricted.

It is common for the producer to blame the ignorance and incapacity of the merchant—the middleman between himself and the public—for lack of enterprise in taking up his industry's best and most original productions. The constant failure to convince the merchant of the merits of more original and better design has hindered and almost paralysed further effort. Especially is this so in the wallpaper industry, where, with rare exceptions, the producers have no facility for placing their best directly before the public.

It sometimes happens that the designer comes directly into contact with the textile

merchant operating apart from the factory, who depends directly on the designer, not only for artistic but also for technical ability. In these "dealers in specialities," as they are defined by the trade, no direct contact with the public is possible. The public voice reaches them through the retail buyer of the large and small shops, who has rarely any artistic conviction to influence his salesmen to "push" the most beautiful productions, but rather to push that which yields the largest profit. Of the various channels through which design has to travel in order to reach the public it will be interesting here to consider the influence of the salesman in direct contact with the public, and to this end, if you will allow me, I will read a letter from the director of one of our leading decorative textile emporia in London.

Relationship of Designer to Industries.

It may be gathered from the conditions which I have mentioned, especially taking into account the overproductive machine, that the relationship of the designer to the industries is a difficult one. How can it be otherwise when design is almost a superfluity, and there exists so little power in the producer to create an excellence or an originality which shall elevate it from a base competition ?

The industries depend upon the designer only just so far as excellence of artistic expression is needed. If all that is needed is a slavish adherence to past commercial successes or to copying museum specimens, then the office boy "with a taste for drawing" is almost all that is required. As things are, the designer novice will be always waiting, cap in hand, a dependent and mere "hack." It will take him many years before his relationship is anything like that of prophet and guide, which is the only relationship that makes the vocation worth while to the man of any ambition. The designer is without credentials or diploma, and seeks by the merit of his production a relation with industry which lasts only so long as that production remains in favour with the public. With a reputation for both technical and artistic efficiency, and having once gained the confidence of industry, his relationship becomes more and more intimate. No diploma or other standing is of the slightest value. Do not, however, be misled into the belief that the artist can be absent from the source of design supply. Industry is quick to discover and reject the mountebank or the charlatan. No mere exploiter of artistic labour can ever hope to establish a close relationship. Industry does not, as yet, buy its designs from the "Stores," and the design is, after all, so much professional advice put on the paper inseparable from the individual.

Design Supply to the Industries Considered Economically.

From my foregoing remarks I must have convinced you that the demand for design is almost fully met. No difficulty is experienced by the various industries in procuring such quantity and quality of design as is necessary for maintaining what they consider an effective output. As a result of careful inquiry in the wallpaper industry, with rare exceptions, I find this to be the case. The exceptions are those houses dependent upon a highly specialised production—perhaps leaders in one of the branches of this industry who are always in want of something rare, something of the highest merit on certain accepted lines. This want, they say, is never supplied; they will rarely risk anything on the encouragement of it, and the loss on an unsatisfactory effort on the part of the designer to produce this special result is invariably borne by the designer. We will, therefore, take this special demand for what it is worth; it does not alter the material fact that the supply of designs is such as to give no cause for concern to the industries, either as regards quantity or price. The dependence, therefore, of the designer on trade generally is infinitely greater than the reverse (which all tends to lessen his value and the value of his production). The average producer will unhesitatingly admit that design is too cheap; but he will ask you to consider the price at which he sells his textile, and the excessive competition he contends with. The designer may retort that by excellence of design, and its better recompense, he may lift the producer's textiles out of, and above, competition. But no, even a penny a yard for the designer will place the goods, says he, outside the market. The retail buyer has standardised the goods apart from any question of design. Such deplorably low valuation of design must surely be remedied. But accepting it, if we must, for the present, what can be done to meet it? Must designers meet trade on its own ground, and make it an economical industry, as is done in Paris? The decoration and dress textile trade have here raised up a special class of worker who meet it with something like the appearance of success. Without discussing the merits or demerits of the trade studio, the longer experience I have of pattern-design the

more am I convinced that design production, to be of any permanent value as a vocation, must, under the present conditions, be an industry in itself, and must consist in an economic organisation of variedly skilled workers.

And now that we are seriously considering the effective employment of the art students from our schools, would it not be wiser and more profitable for them to become part of such an organisation in closer touch with trade? It appears to be the only solution of a problem continually facing us. We in England could then compete more successfully with the Paris and German trade studios, and our industries need not be so dependent upon the foreign designer. I am sure at least of one thing: it would put a stop to the present enormous waste of serviceable workers who are now launched into the world as so-called designers.

It is doubtless owing to the many inefficient workers (the great part of them emanating from our Government and municipal schools) who go round the trade seeking the sale of immature efforts at design, that not only the value of design, but the trade's estimate of the value of designers as a paid class of workers, has been lowered.

May I here give you a recent instance that came to my notice?

One of our tapestry manufacturers in London, whose factory is in Belgium, and who has a large trade with the better-class decorative textile emporia, made me the proud boast that he obtained all the sketches he required at 20s. apiece, and, further, that he could buy tons of them at that price if he wished. But this is what I want you particularly to note. If these sketches were carried out further as practical designs, he would be willing to pay much more; but the men he employed did not possess the knowledge or inclination to do so.

Whether the raising of the standard of technical excellence in design submitted to the trade will raise the trade's estimate of the value of design and designers remains to be seen. I feel sure it will, as I am equally sure that, if in the last fifty years British industry had been served by a British school of design of greater efficiency, it would have compelled a higher value.

Now, as to the building up of such design industry as I have suggested, from what class of the community are we to draw our labour? Just that class that presents itself now, which both the Government and municipal bodies have been attempting to turn to profitable account, by scattering it broadcast into the camp of the rapacious trader.

Lewis F. Day, to whom designers owe so much for his lucid writings on ornament, and whose recent death is a great loss to us all, in an address to the members of the Design Club ("The Annual of Art Work," p. 27), said:—

The assumption that for a designer in any way to accommodate himself to economic or other conditions is to betray, or even degrade his art, is altogether unwarranted. I protest against it with all my might; and maintain that it is perfectly possible to be ready to meet the inevitable conditions to which design is nowadays subject, and yet to keep one's artistic soul alive.

Lifelong experience in design for trade and manufactures has not altered my conviction that a man may be ready to meet all the conditions to which design is subject.

I am fully aware that, in attempting to attack this economic problem, I am shocking the soul of the artist who is out to give of his best for Art's sake, but I am doubtful if there are any remaining who would not give much for the shelter of such an enterprise wherein he would receive a better reward for his labour. Think of the enormous waste of a gifted designer spending his time trying to find a market for his work. It is this side of the vocation that has driven many a good man out of it.

It would have been of considerable value, in dealing with this economic side, to ascertain (if it were possible) from the various British decorative textile industries the annual sum of money spent on designs with the outside designer here and abroad, and make some comparative statement, together with the wages paid to designers and art workers employed in the factories. It must amount to a very large figure; but the question then to consider is, How far this will go round, and whether the reward to the designer is not grossly inadequate, when it is frequently the prime factor in the value of the textile?

This much information, however, I have been able to gather from the British Wallpaper Combine, with its three millions capital. They purchase annually, in their various branches, 2,000 designs at an average price of £4 each, and out of this number 600 have been bought from the German designer, and fully 800 from Paris; thus, we will say, leaving 600 to be shared among British designers.

Also, as regards cotton-print designs, the C.P.A. purchase two-thirds of their designs in Paris.

In making any computation, however, it must

not be forgotten the British designer can and does sell designs abroad to the French, Belgian and German textile industries.

Copyright.

For a correct estimate of the economic value of design, we must not only take into consideration how the industry is protected by its own interests, but how it is protected by law. The law of copyright in design is still hopelessly inadequate to prevent colourable imitation, and the process of law is too expensive to facilitate speedy and effective action, while on the side of the designer the expense of any action must be borne by himself. The registration is inexpensive enough, consisting of the lodgment with the Patent Office of three photographs of the design with a fee, which in each section of the textile industry is: for wallpaper, *5s.*; for printed cotton, *2s. 6d.*; for tapestry, *2s. 6d.*

I need not remind you that a revision of the Law of Copyright and payment by royalty would put an entirely different complexion on the vocation of design, and would at the same time improve the position of the producer.

To sum up the economic aspect of design as applied to the textile industries, it would be misleading should you think that good design is not still required. The demand is there, but the over-production in the one and "selling" style leads to excessive and unfair competition in which the designer is made to suffer in an excessive ratio to the producer.

I now come to one of the most vital and important questions—

Education of the Designer.

Shall our Government and municipal bodies go on spending money on the education of the designer? Do the results of the past justify them in training more workers to fill an already over-supplied demand? We will admit, and I think they are now prepared to admit, that more practical lines should have been followed. The teacher of pattern-design has generally been entirely ignorant of trade requirements and technical processes. The young person who has been taken away from his trade for better Art education, that he might the better follow it after a course of study, has either found his way into the profession of teaching or has become a painter of pictures, or has, by misdirected effort, missed his way entirely. There has been a marked deficiency in the specialisation of the Art worker, and no connecting link with trade. Now, in this matter of pattern-design for the decorative textile industries, over 200 Art Schools throughout this country are at this moment still training students to become designers with a vague idea that pattern-design is of a value exceeding that of any other skilled work. All these young aspirants are going to be creative artists. What are we going to do with them? Let them take a two or three years' course and so lead them into a blind alley? No, the time has come when we must take this matter seriously. If industry still wants design, and is prepared to give it a decent wage, we shall have to concentrate and centralise any further effort, and bring to bear upon it, at the same time, a greater specialisation. Get into line or link up with trade and try to know its laudable aims. Educate the would-be designer to become an intelligent salesman, or anything to make him feel he is adding to industries, economy, and the advancement of Art. The showrooms, the warehouses, and the factories of England want men of equal intelligence with those of France and Germany, and they have not yet got them. It is the earnest and thorough workman that is wanted, not the dilletante artist who lives upon the chance of selling one design a month.

It is only through the efficient artist-workman, with much studio and trade experience, that we can arrive at anything like the designer with the qualifications that I have before mentioned. Let there be less confusion of mind than appears to exist in those responsible for the teaching of design in our schools. Once the student has shown a facility in pattern composition, it would be better to leave design entirely out of his curriculum and direct his whole attention to attain perfect draughtsmanship. Design will take care of itself. It is a very common attainment, even in the kindergarten, and it is valueless to Art industry with neither artistic excellence of rendering nor technical knowledge to accompany it. The employer of artistic labour, whether it be in the factory or trade studio, requires good workmen, good draughtsmen—not indifferent designers—workmen who know their immediate craft of drawing and painting, who will take infinite pains to render what to the average Art student would be the unconsidered details, yet to Art industry as a whole details are most essential and valuable.

The student must study the best historical examples of the particular industry he has elected to follow, and he must keep his mind open to receive any impression outside this. He must appreciate at their true worth, and on

their peculiar merits, all styles, whether Indian, Chinese, Jacobean, and all styles which are used n modern decorations. These may be so-called "decadent" styles, but are not to be ignored on that account, as more often they will claim greater powers of draughtsmanship. Take such a style, for instance, as Louis XV. Rococo. Without perfectly dexterous draughtsmanship it would become hopelessly debased and vulgar. Or take the Adam style. Without a perfect appreciation of its peculiar merit of chaste and beautiful proportion, it would become characterless and insipid.

In addressing the student for trade design on this matter of historical style, I would impress upon him the importance of cultivating its more perfect acquaintance. He must not fall into the temptation of thinking he is going to make a sensation in the world by the creation of a style all his own. It is not easy to be original on acceptable lines. Then I would ask him to consider in what originality consists—in what unexploited realms is he seeking originality? Let us suppose it is the realm of Nature, the source of all inspiration. He succeeds in cultivating a manner all his own—we will call it a personal style, unrooted in any past historical style. What is industry going to do with it?

Exploit it for two years, at most five, and then cast it out?

No! Let the student think less and talk less about originality, and give industry what it wants far more urgently—perfect workmanship. It is only through this that the perfect creative artist emerges. Lewis F. Day, speaking to designers, said: "I think it would be more decent of us if we did not claim to be artists, but just called ourselves workmen, leaving it to others to say if we were something more."

The Future.

Admitting that the Art workman for the textile industries has been unpractically trained and misdirected; admitting the want of education in the salesman and the factor; admitting that the economy of machine industry has reached a crisis and urgently calls for better government; admitting that the designer is under the heel of the trader by reason of over supply—what are we going to do?

Is it not possible in this country to find a means of giving some practical assistance to prevent its Art from becoming a negligible quantity, a sweated industry, and to help to elevate design to a place more worthy?

I can hope in the future—if the industries can combine to greater concentration on separate special lines of work; if the educational authorities will recognise the urgent necessity of some economic control; if better terms can be made between industry and the designer. Art has made a poor bargain with industry. No good Art was ever achieved without encouragement and support from either Church or State or individual. Take this away, leaving it to the tender mercies of commercial enterprise—the conditions of which I have given you—and it would be foolish to expect any other than now obtains. Indeed, I am surprised it is as good.

When one thinks of the advantages that have been ours since the industrial awakening of England at the great Exhibition of 1851 (which this Society of Arts inaugurated and carried to success), the enormous sums of money spent by the State on the education of the student of Industrial Art and on the priceless collection of objects in that palace of art, the Victoria and Albert Museum in London, and other museums, it is deplorable that so little has been accomplished. Our textile industries still buy the bulk of their designs in Paris. Germany has been supplying our great wallpaper Combine with more than one-third of its annual demand for designs. Our best and most efficient draughtsmen are imported from France, and our best engravers from Alsace and Germany, while our Government-trained student of pattern-design is either unemployed or has drifted into other work. It is idle to say this is the fault of trade for not wanting Art. It is the fault of those advisers on matters of Industrial Art training who have set themselves to the quixotic task of tilting at the windmill of commerce, so that Art has been thrown naked and undefended into the cruel arena of a trade governed only by a profit-making standard.

In conclusion, it is gratifying to find among these industries of which I have been speaking some producers who are still conscious of the true value of the artist—men of good taste and artistic sympathies. They recognise that Art cannot flourish in anything but a generous atmosphere, and these men, we feel sure, will become leaders in their trade. They recognise also that the public upon whom they depend, whatever their choice of style, will, with rare exceptions, always choose the *very best* of that style. We designers, therefore, cannot do more than strive for this best, and never rest content in taking a place inferior to that of the foreign competitor.

We can, I fear, never look upon the profession of design as anything approaching in importance that of the architect or painter. It is, and always will be, a small profession, whatever importance it may have in the eyes of the State as influencing its industries for good and helping towards a higher appreciation for design. It will remain by reason of its limitations one of the lesser Arts. Certainly in its relation to the decorative textile industries it will never attain to a position of command, but must rest content with that position of servant and guide.

[Mr. Wilcock desires to take this opportunity of thanking the following firms who kindly lent specimens of textiles to illustrate his paper:—Messrs. Maple & Co., Ltd., Tottenham Court Road, W.; Messrs. James Shoolbred & Co., Tottenham Court Road, W.; Messrs. Harrod's, Ltd., Brompton Road, S.W.; Messrs. Story & Co., Kensington High Street, W.; Messrs. Warner & Sons, Newgate Street, E.C.; Messrs. B. Burnet & Co., Ltd., Garrick Street, W.C., and Messrs. Stonards, Ltd., Paternoster Buildings, E.C.]

DISCUSSION.

The Chairman (Sir Charles Waldstein, Litt.D., Ph.D.), in opening the discussion, said it was always a great privilege to listen to a man who had not only considered the theoretical or literary side of his work, but who was himself a producer, and at the same time had pondered much over the broader aspects and the essential philosophic questions of his vocation in life. Such a man was the author. But he (the speaker) had to confess that, with all the numerous suggestions the author had made, and which set one thinking in so many directions, he was confused. He had taken up many of the suggestions and tried to follow them out. They had led him in one direction, and then the author at once had sympathetically drawn him in another, and he did not know, as Chairman, at the end how to summarise them all, or how profit was to be gained most directly by the author's vast experience and eloquence. For instance, the author had enjoined upon the artist who had devoted himself to art industry, and the tradesman who was inspired by artistic ambitions, the fact that they could not command, but were only servants and guides. The author was much too humble, and he had been at times too kind to the public, and, still more, too kind to the intermediaries who stood between the public and the artist. He (the speaker) did not agree that there was an essential difference between the artist and the designer—the art worker. From one point of view, every artist, however lofty his ideals of his art, worked for a public. He did not stand in rapt admiration in his study—be he sculptor, or painter, or musician—and gloat upon the beauty of his own realisation of Art with nobody else to see it. And, meanwhile, how was he to live unless those who did see it and admired it would pay for it and help him to live? He (the speaker) quite admitted that the designer could not appeal so directly to the public as the painter, sculptor, or musician could do. Very often he was worse off, and could not get a public at all, but he had ultimately to go to the public. The thing the designer had to complain of was the tyranny of the trade, and the tyranny, to a greater extent, of the middleman, who stood between the public that admired, and that could be made to admire, and the production of the work which really and honestly did appeal to them. The middleman did not consider those points, but was led away by other considerations which had nothing whatever to do with the intrinsic artistic quality of industrial art itself. One of the most admirable suggestions was that such middlemen should be educated and be brought more directly in touch with the artistic side of the designer. No good salesman or manufacturer should be devoid of education on the artistic side and on the industrial side of the goods in which he was dealing. That was one of the great problems of modern industry all through. A man who dealt in textile fabrics or decorative work should know all about their manufacture and be a man of taste himself. But how could this educative work be carried out? He had expected to have heard some more definite suggestions put forward by the author. Allusion had been made to the Arts and Crafts Exhibitions. They were good, but they were limited almost exclusively to hand-made work. Nobody valued more highly than himself the beauty of real handicraft work, but were we to turn our backs on machine work? Was it not possible to have exhibitions in which, side by side with the handicrafts, were also machine-made goods? And could not something be done to abolish the stupid antagonism between art and craft? Every true artist was an artisan. In conclusion, he would ask the public not to be too hard on the State-aided institutions. They had done much good. If it had not been for them, where would be the interest in Art throughout the whole country? Where would the young men be who, after all, were learning to draw there? and what was the trade going to do if people did not know how to draw? Were those young men going to be prematurely taught from the practical point of view on childishly made instruments which were to represent the processes of manufacture, before they even knew how to draw, before they had an artistic taste or education, which the schools must give them? Many suggestions were being made as to how to reform the Art Schools. How could such be carried out? Once give the schools the means of educating the public, and once give them a more immediate touch between the designer and the public, and the tyranny of the fashions and the tyranny of the trade might possibly be overcome.

Dr. William Garnett (Educational Adviser to the L.C.C.) said that he knew little about Art or design, nor was he an economist, and he supposed that it was in consequence of his interest in educational work that he was called upon that evening to say something in defence of the Art Schools. The author stated that artists cultivated Art and forgot the public. It seemed to him (the speaker) that the tendency of all academic schools must be to work independently of public demand; and they were not to be entirely blamed for that. Once the questions were introduced, Did it pay? Would the public take to it? all the highest work of our Universities and our Schools of Art would be destroyed. The great discoveries upon which practical inventions had ultimately depended had been made by men who had worked at science for the sake of science, and not for the utilitarian results which might have been expected. He quoted in that connection the history of the dynamo and wireless telegraphy. But that was not all that was required. Men were wanted who would put one hand on industry and the other hand on science or art, as the case might be, and act, as it were, as the mediator or interpreter between the two, and then the great discoveries of the scientist would be made available to the practical man for the development of industry. Such a man was Lord Kelvin. Kelvin's success in one branch of his work was due to the fact that he was a practical yachtsman as well as a great electrician, and he combined his experience of navigation and of the wants of navigators with his knowledge of electricity and magnetics and mechanics, and so produced methods of satisfying those wants. The author said that the designer required to have a nodding acquaintance with technicalities, and not a familiar acquaintance, lest they degraded him. He (the speaker) was ready to join issue with the author on that point. The nodding acquaintance of the science man with technicalities was good; but a more intimate acquaintance was better, provided that he confined himself to his science—that he was not a worse scientific man because he was the greater technical expert. He (the speaker) pointed out that it was through the association of the technical expert, James Watt, and the Professor of Physics in the University of Glasgow that the steam-engine had come to be a practical working agent in all our factories. All he (the speaker) had said about science he thought applied equally to art. Schools of Art properly developed Art for Art's sake; but the industrial Art School (which was, or might be, a thing a little different from Schools of Art) must take the very best of the work of the Schools of Art and must adapt it to the requirements of industry. That was where, perhaps, our educational institutions fell short. The public was master of the situation, and the public could only be led by the expert very gently indeed. First of all, the public wanted machine-made goods because it could not afford to buy purely hand-made goods. Therefore, if Art was to penetrate into the dwellings of the middle classes and the poor it must be through machine-made goods, and art teachers must get that sympathy and that touch with machine-made productions which would enable their pupils to adapt their designs to the requirements of factory industry. There artistic design differed to some extent from scientific invention, since novelty and not utility was the test of success very often in Art work. So the superintendent of the school of industrial Art, while he kept one hand upon artistic development had to keep the other hand very carefully upon the pulse of the public. The weak point in English Art Schools very often consisted in what the author had called unconsidered details. Details, however, were essential to make a design practical. If English Art students who had the genius for inventing a new design would take the trouble to produce it as a German artist would, in such a way that it could immediately be put upon the rolls, or otherwise interpreted into the requirements of the machine, then they might expect to get paid, not only for their ideas, but for their work. As it was, the manufacturer had, in addition to paying the designer for his idea, to pay somebody else to interpret it so as to make it pay.

Mr. John Sanderson said he had always noticed that papers on artistic work contained a note of pessimism; but as far as his own trade, that of the manufacture of wallpaper, was concerned he would like to say that in England the artist, backed by the manufacturer and aided by the suggestions from the decorator, held the premier position in the world. Continental people, who were a little out of the common and desired something really nice, always used English wallpapers, and the same thing applied to the United States. The German producer of designs was to his (the speaker's) mind exactly like the German producer of everything else—he was mainly inspired by the Englishman, and then, with infinite care and pains, produced and reproduced things very much like what Englishmen had produced, sometimes putting rather a practical note into them. He thought the trade suffered very much from the terrible mixture which it had in it of fashion and Art. Other trades were not hampered in that way. With regard to the salesman, he was a man very often shot at and abused, whereas generally he could not help himself. He remembered that, when he first began, an old and practised salesman said to him, "Never mind what you like, or what you think the customer ought to have. Ladies as a rule are the choosers of wallpapers, and it is a most unpleasant business to attend to them. They flutter from one flower to another like butterflies. You watch them flutter, and the moment they show any signs of alighting on one flower, nail them to it!" That was very practical advice, and he had found it answer very well. Coming to the main point of the paper, he was

puzzled to know what to say. The result of the teaching of the students was no doubt unsatisfactory. He was constantly getting letters from philanthropic ladies and others who took interest in boys, saying that the boy's Art master considered him a genius, and sending up drawings which the boy had made. Well, the drawings were very good and as correct as they could be; they conformed to all the rules of design, but they would not sell. He thought that if many of those lads, after learning to draw, were sent into a warehouse to earn their living, at the same time getting an outlook on the world and on their own particular industry, and attended Art classes with the discrimination of a man instead of the easy appetite of a youth, it would not only give them a better education, but would sift out those who had not enough genius to become real designers, but who would probably become good salesmen and workmen, or who even might go into the handicrafts. Perhaps something of that sort could be managed, but it would be for the artists themselves to do it; the manufacturer, or the middleman, or the salesman, or the public would not be able to assist very much in that respect.

Sir Cecil Harcourt Smith (Director and Secretary of the Victoria and Albert Museum) said there was not much he could say, being a public official; but the author had mentioned the Victoria and Albert Museum, and he should like to state how extremely anxious all those who were connected with the Museum were to identify themselves, as far as possible, with the interests of industrial Art of to-day, and not only with that of the past. He very much hoped that when matters became more settled it would be possible, with some space which would be reserved, to arrange for an annual exhibition, or perhaps even more than one, showing what the industrial Art of to-day was, pending the institution of some building which would deal with the matter much more thoroughly. He thought it was a very essential thing for the interests of industrial Art of to-day that there should be some institution which made it a point of showing to the public at large and to manufacturers and to salesmen what was being done generally throughout the industrial trades; and, more than that, that there should be some place where experiences could be exchanged, where people could meet and discuss points which really interested one and all.

Mr. W. Foxton said it had occurred to him whilst listening to the paper that the author was advocating a sort of trades union for designers. He (the speaker) could not agree with him on that point. Mr. Wilcock was a very good example of the survival of the fittest, and if he could bring about what he desired in the way of a trades union for designers, he (the speaker) thought it was very possible it would foster a lot of mediocre members, and that the good results which were being obtained to-day would not continue.

The Author, in reply, said the discussion had not been quite as practical as he wanted it to be. He had not submitted any suggestions; in fact, he had purposely refrained from doing so. He thought certainly that the suggestion of Sir Cecil Smith was an excellent one. They all looked to the Government. There was not the slightest doubt that if only the Government could put its mark upon the good men it would immensely raise the status of the designer, but they must be the fittest of the lot. He did hope that the schools would take warning not to bring too many men into the market, because the result would be disastrous. It would be a very proud thing for him to say he had done something to link together commerce and Art. He was doing what he could. He felt the schools had been keeping far too aloof from the trader. They had never troubled to understand the trader's needs or requirements. If sympathy could be brought about between the one and the other they would come together in the very near future.

Mr. Alan S. Cole, C.B., writes:—I am sorry to be prevented from attending the meeting when Mr. Arthur Wilcock is to read his paper on "The Decorative Textile Industries and the Designer's Relation thereto." Having had the privilege of seeing a proof of the paper, I have jotted down a few remarks which I should have offered in the course of the discussion following the reading of the paper.

The subject of decorative textiles is one that has interested me for many years, particularly the apparent evolution of processes to produce such textiles, as well as that of their schemes and styles of ornament. Mr. Wilcock, with the advantage of long successful practice and wide, fruitful experience, in close touch with the modern trade and methods, has dealt with phases of them.

It is on the strength, or weakness, of my past official connection with the now defunct Science and Art Department and the South Kensington Art Museum that I propose to question the validity of one at least of the opinions at which Mr. Wilcock has arrived, namely, that "it is deplorable that so little has been accomplished" in view of the advantages the country has obtained since the great Exhibition of 1851. I readily admit that his contention is applicable to results obtained during the present century; but I venture to think he has not considered adequately the condition of things as it was in 1851 and the results of work for the remaining years of the last century.

The Department of Science and Art and the South Kensington—the Victoria and Albert—Museum were the immediate outcome of the 1851 Exhibition, and were means by which it was hoped to stimulate the education of producers and consumers of Art manufactures and of Art productions generally. The fostering of these means was regarded suspiciously at first by Parliament, who reluctantly made grants of money to aid it,

In the then controlling official administrative circles the possible value of a system to encourage public intelligence in Art manufactures does not seem to have been appreciated. A few members of both Houses of Parliament were able to spur on officialdom; and a general system grew which included the careful development of the functions of the Science and Art Department, and the National Art Training School at South Kensington, with the Art Museum. A specific object was kept in view and was aimed at for achievement through this system.

The basis of the general system as it affected institutions in the country, apart from those at South Kensington, was co-operation between local efforts and the assistance given by Parliament. At starting, this co-operation put life into some dozen moribund Schools of Art (or design, as they had been rather erroneously called), and called into existence many more Schools of Art. The management of them was local, and for local purposes. The conditions for distributing Parliamentary grants were comparatively simple and encouraging. But as time went on, although Parliament became more generous, official conditions for distributing the Parliamentary grants became more complex and restrictive. Local management seemed to lose much of its vigour in making the local schools beneficial for local purposes. Still, it is well on record, at least of the last quarter of the nineteenth century, that educational and industrial authorities in France, Germany, Russia, and other European countries, recognised our Schools of Art, our South Kensington Training School and Art Museum, and our artistic manufactures with admiration. Indeed, our Art manufactures stood very high in the foreigner's estimation, especially that of France. Parliament continued to increase its grants; but officialdom increased its shackles on local action, and thus within the last twenty years officialdom has, I think, become mainly responsible for the spread of an opinion that our machinery to improve Art manufactures has not latterly secured proper results. But I think that Mr. Wilcock goes too far in deploring what has been done in the course of sixty years or so. Mr. Wilcock talks of "our Government-trained students of pattern designs"; and such, no doubt, they have gradually become. It seems, however, that were the existing forms of official control in distributing the Parliamentary grants to be very greatly relaxed, Schools of Art would obtain greater freedom of action in training students for the benefit of local needs, and misapprehensions about "Government-trained" students would be diminished, and this with advantage to all concerned. In fact, a return to the original and definite policy upon which the whole system was launched is much to be desired. I know that in high quarters an opinion has been expressed that Teutonic methods of education are good examples for this country. But we are now learning otherwise. However much we may grumble in a healthy way at our Art institutions and schools and their influences, do not let us forget that British local efforts, aided by Parliamentary grants, have provided us with a better network of fine technical, scientific and artistic institutions than any other country possesses. It is possible that we have not of late years made the best use of them, but that, I think, is due to causes such as I have referred to.

Mr. Wilcock alluded to the industrial Art works of our time, and that among the best of them many may be found of sufficient excellence "to have a place in posterity." He may have overlooked the fact that the Board of Education is the guardian of a certain number of such works, and not British works only. They do not, however, find proper places in the collections of the Victoria and Albert Museum. I think, therefore, that the Art collections at South Kensington might very usefully be reorganised and displayed, with the distinct aim of encouraging, amongst producers and consumers, knowledge of the world's history, brought up to date, of Art manufactures and decorative work. The Museum's original purpose was to be an adjunct—an encyclopædia, as it were —to the National Art Training School or Royal College of Art, and also to serve the local Schools of Art. At present, in the vast premises of the Victoria and Albert Museum, Art collections are becoming perplexing through redundancy of similar examples; and at the rate at which gifts and bequests of almost any works of art are accepted, and made much of, the redundancy and perplexity are increasing. Enormous ranges of wall and floor space are covered with types and examples duplicating and triplicating themselves, over-illustrating the same methods of production and styles of design and work. The clear and original educational function of the Museum is quickly becoming befogged. Through the influence of such papers as Mr. Wilcock's, and discussions of them under the auspices of the Royal Society of Arts, a powerful lever can be brought into action for the release from official thraldom of the country's efforts to do steady work to benefit Art industries.

Sir Cecil Harcourt Smith writes:—First of all, I should like to express the pleasure it gives me to listen to the views of a practical designer as well known as Mr. Wilcock on such a subject as that of design. This question is, of course, one that most intimately concerns the Victoria and Albert Museum and the Board of Education generally, and it is of great importance that we should know what is the view taken by him and his colleagues of Government efforts in this direction. One of the chief difficulties which, I suppose, confronts all of us, is that of co-ordinating theoretical instruction in design with the practice of it. Personally, I have always felt that one of the biggest factors composing this difficulty is the machine, which, as he says, has never been yet sufficiently recognised in its relation to theoretical instruction in design.

I must confess to being somewhat depressed by the view that in the ordinary economy of things the designer, even of a successful product, must be content to resign any hope of recognition by the public. I cannot really think that the case is as bad as that. If it is so now, it must be surely because the conditions of artistic trades are not yet properly adjusted to new circumstances, and a time must come when the best work will always achieve a position above the mere impersonal.

As I understand it, we are confronted with two opposed propositions, roughly as follows: on the one hand we have a quantity of cheap goods which command a ready sale, but which are for the most part of bad design; on the other, we have a plethora of good designs for which there is no market. One of our chief difficulties seems to lie in the co-ordination of these two facts, which is, after all, to some extent, a question of education, and which involves the establishment of the truth that what is cheap need not necessarily be nasty.

EMPIRE NOTES.

Australian and New Zealand Exhibits at the Panama Exposition.—Notwithstanding the war and the part which Australia and New Zealand are taking in it, both these countries, with a view to extending their trade relations with the United States, have determined to avail themselves of the opportunity afforded by the opening of the Panama Pacific Exposition, and are therefore sending large and carefully-selected cases of exhibits to San Francisco. These will be placed in the special buildings which have been erected for them. The Australian building, which is finished in native hardwoods and fitted with show-cases and furniture made from Australian timbers, will contain exhibits of wooden articles, products of the pastoral industry, including over 600 fleeces, minerals—among which is a collection of opals valued at over £7,000—corals and shells, agricultural products, tanning materials, furs made from the native bears, kangaroos and sea animals, rubber and cotton, fish and birds, glassware, native weapons and specimens of native work. In connection with the building is a park and aviary, in which will be shown a number of animals and birds in appropriate surroundings. There are two cold-storage rooms for meats, fresh fruits and dairy products. The New Zealand exhibits will consist of frozen meats, fresh vegetables, cheese and butter, fibre, hemp and flax, grains and native grasses, wool and woollen goods, and minerals. These will be displayed in the Palace of Agriculture, in which the New Zealand Government has taken over 14,000 square feet of space. In the New Zealand building, specimens of Maori art and weapons, trophies of the chase, and kauri wood and gum will be shown, while in a large conservatory there will be specimens of the native flora. Both the Australian and New Zealand buildings are equipped with moving-picture theatres, in which films illustrating the scenery, life and industries of the countries will be shown. Altogether the exhibits promise to be an impressive demonstration of the resources of Australia and New Zealand, and will doubtless prove of service, in the interests of settlement and trade, to both countries.

Rhodes Scholars from Greater Britain.—According to the statement for 1913–14 of the trustees of the Rhodes Scholarship Fund, the number of scholars in residence at Oxford was 177, of whom 76 were from the British Empire oversea. Since the beginning of the war, a large number of the British students have taken commissions or enlisted as privates in the Imperial Army or in the contingents of the various Dominions. These will resume their scholarships at the end of the war. Twenty of the 88 United States scholars, included in the above total, have been given leave to assist in the work of distributing supplies under the auspices of the International Commission for Relief in Belgium. The following list gives the lines of work taken up by the 504 Rhodes scholars who have completed their terms:—Education, 167; law, 130; clerical work, 20; social and philanthropic work, 8; medicine, 31; scientific work (research), 8; engineering, 4; mining, 4; diplomatic and consular service, 6; Civil Service—(British Empire) 22, (U.S.A.) 3, (Germany) 33; Army—(U.S.A.) 1, (Germany) 1; journalism, 13; business, 22; farming, 12; miscellaneous, 4; unsettled to date, 11; and unknown, 4.

The Decline in Emigration.—Before the beginning of the war there had set in a considerable decline in emigration, arising from the better trade conditions in the United Kingdom and from the less favourable conditions, allied with the slackening of efforts on the part of the various Governments' advertising agencies and propaganda, in the oversea Dominions. The incidence of the war, however, put a final stop upon the outward movement, as the Board of Trade statistics show. In 1913 the number of emigrants was 389,394. In 1914 it was 214,138. The arrivals, on the other hand, numbered 85,709 in 1913 and 104,995 in 1914. The net emigration figures, therefore, which for 1913 were 303,685, for 1914 were 109,143, showing a falling-off of no less than 194,542. The emigration to Canada fell from 190,854 in 1913 to 78,305 last year; to Australia, from 56,779 to 32,388; to New Zealand, from 14,256 to 7,871; to South Africa, from 10,916 to 7,785; to India and Ceylon, from 6,810 to 6,751; and to other Colonies from 5,432 to 4,996. The totals for the British Empire were 285,046 and 138,096 respectively. Emigration to the United States

also fell from 94,691 to 69,705, and to other foreign countries, from 9,657 to 6,337. It is interesting to compare with these figures those for arrivals during the two years. Those from Canada, which were 26,288 in 1913, rose to 34,050 in 1914; from Australia, 12,351 and 13,510; from New Zealand, 2,446 and 2,869; from South Africa, 10,541 and 11,267; from India and Ceylon, 5,928 and 7,958; and from other Colonies, 3,971 and 4,977 respectively. The totals from the British Empire oversea were, for 1913, 61,525, and for 1914, 74,631. From the United States the arrivals in 1913 were 16,619, and in 1914, 20,890, and from other foreign countries, 7,565 and 9,474. It will be seen that in all cases the arrivals for 1914 exceeded those for 1913, and that in the case of South Africa, India and foreign countries, with the exception of the United States, the numbers arriving in the United Kingdom exceeded the departures. There is no doubt that, at the conclusion of the war, these figures will be reversed, and, so far as the British Dominions oversea are concerned, necessarily so, if those Dominions are to be peopled with British settlers and to continue to grow into strong British communities.

Snow as a Canadian Asset.—The *Brockville Times* of Ontario, referring to a recent snowfall in Canada, describes it as "a blessing to the country and a commercial and sanitary asset, which should be valued as such." Dealing with the latter point, the paper says that the fall was "hailed with delight by everyone, not only because it created good seasonable winter conditions and encouraged business, but because it cleared the air and laid the dust which was filling the houses and stores and the lungs with germs." This view was confirmed by the *Toronto Globe*, which says: "Some day, Canada will be proud of the title 'Our Lady of the Snows,' which Kipling conferred upon the Dominion." Evidently the people of Canada are beginning to realise, in view of the reduction in the snowfall which has been experienced in the last few seasons, that snow has its value, both as a fertiliser and an atmospheric cleanser. At one time, however, it was thought necessary to repress, as far as possible, any reference to the hard winters with which Canada was usually visited, for fear that intending settlers might be frightened away from so inhospitable a country. But now that the diversity of climate which Canada possesses is becoming more fully recognised, and the fact is better known that her winters, though in some parts severe, are dry and bracing, accompanied for long periods with bright sunshine and affording facilities for easy transport, social gatherings and exhilarating winter sports, the belief is growing that, instead of being a drawback to the people of moister countries, the winters of Canada may prove an attraction. This feeling among Canadians is certainly likely to be fostered, after the experiences of the Canadian Contingent on Salisbury Plain, where rain and mud have given the soldiers of the Dominion a much higher opinion of the winter seasons in Canada than even they had before, and a conviction that snow, under a Canadian sun, is far preferable to the slush of an English winter, under a leaden sky.

The Coal Measures of Queensland.—The Queensland Geological Survey publishes some useful particulars as to the coal measures of that country, by Mr. B. Dunstan, in which, while dealing specially with individual coal areas, some general facts are given. Of a total area of 73,000 square miles, representing the geologically surveyed measures, the recognised coalfields cover 20,000 square miles. Most of the present supply comes from the Trias-Tura measures, mainly confined to the south-east of the State, covering an area of 83,000 square miles, which includes an area of 2,000 square miles of coalfields, proved to contain coal seams, whether workable or not. The permo-carboniferous formations, covering 30,000 square miles, include 16,000 square miles of coalfields. These lie further inland, and are still largely untouched, but with the development of communications will be an important source of supply. The cretaceous measures (20,000 square miles, with 2,000 of coalfields) are of less importance, the quality of the coal being inferior. The writer endeavours tentatively to estimate for each coal area the actual probable and possible coal reserves in existence, limiting the calculation to seams not less than a foot thick, and not more than 1,000 ft. below the surface. The general result is to show that the basin of the Dawson-Mackenzie Rivers contains far more probable resources than all the other parts of the State put together. The mammoth seam in the Mackenzie River area has a thickness of 20 ft., and the probable reserves, estimated on the assumption that one square mile round a spot is the limit of probable occurrence, are put down as 450,000,000 tons. The Clermont area, with a seam of 66 ft., but of less extent than the Mackenzie area, affords a probable reserve of 300,000,000 tons. Queensland's yield of coal in 1910 was about 870,000 tons, or 11·37 per cent. of the whole of Australia. The output has been gradually increasing, from 323,068 tons in 1895 to 891,508 tons in 1911, the total to the end of that year being estimated at 13,251,883 tons. Although gold-mining is an important industry in Queensland and in other Australian States, it is evident that coal will exceed it in importance, as the industries of Australia, which are only in their infancy, become more fully developed.

The Murray River Storage Scheme.—An important step towards carrying into effect the proposal for locking the Murray River in

Australia has just been taken by the introduction of a Bill in the Victorian Parliament, to enable that State to carry out its share of the agreement made between the Commonwealth and the States of New South Wales, Victoria and South Australia. The proposed work, it is estimated, will cost £4,440,000, towards which the Commonwealth and South Australia are each to provide £1,000,000, and New South Wales and Victoria £1,220,000 each. The works will comprise:—(1) The provision of storage at Cumberoons, or some other suitable site in the Upper Murray; (2) a system of storage at Lake Victoria; (3) weirs and locks on the Murray, from its mouth to Echuca; and (4) weirs and locks on the Murrumbidgee, from its junction with the Murray to Hay, or, alternatively, at the discretion of the New South Wales Government, weirs and locks on the Darling from its junction with the Murray. The works on the Murray above its junction with the Darling are to be constructed by New South Wales or Victoria, jointly or severally. The provisions relating to the supply of water to South Australia may be varied in drought times, and the minimum quantity to be allowed to pass shall be sufficient to fill Lake Victoria storage, and with it maintain a monthly supply at the outlet of the lake of 134,000 acre-feet from November to the end of January; 114,000 acre-feet during March, September, and October; 94,000 feet during April, May and August, and 47,000 feet during June and July. Such provisions are not, however, to take effect until the Victoria and Murray storage works are effective, or the expiration of seven years from the time when the Act comes into force. The full importance and advantage of this great undertaking can only be realised in a season of drought such as that through which Australia has been recently passing, but, in the general interests of irrigation, in each of the States directly affected the completion of the work will be an invaluable boon to the Riverina and other settlers in New South Wales, Victoria and South Australia.

GENERAL NOTES.

Comité Belge pour le Commerce avec les Alliés.—Steps have been taken to organise an office called for "Commerce with the Allied Nations." The aim is twofold: to secure for well-recommended and fully-qualified Belgians the agency in Belgium of British firms, and to answer inquiries from Belgian firms who are desirous of replacing foreign goods by their English equivalents. Trade papers, catalogues, etc., will be filed in order to give all possible assistance to inquirers. The temporary address of the office is care of The London Chamber of Commerce, 97, Cannon Street, London, E.C.

The Telephone System in Italy.—Under an act of the Italian Parliament of July 15th, 1907, the telephone service in the larger cities of the kingdom was taken over by the Government through the purchase of the plants of the two largest operating companies. Several smaller companies were allowed to continue operations for ten years before being taken over by the Government, and in 1913 the term was extended in some instances for ten years longer. The Government operates the principal long distance lines, and has exchanges in sixty-nine cities. On June 30th, 1911, the latest date for which the statistics are available, the number of Government subscribers was 51,828, and of subscribers to private lines 24,233. The number of Government subscribers in the principal cities was as follows: Milan, 11,207; Rome, 10,025; Genoa, 5,783; Turin, 5,050; Naples, 3,671; Florence, 3,347; Venice, 2,045; Bologna, 1,628; Palermo, 1,293. There are ten principal concessionaire companies. The exchange equipment of the Milan central office is of two kinds—the common battery multiple switchboard of vertical type, and the magneto multiple board of horizontal type. The former was manufactured by an American, and the latter by a German company. There are no manufacturers of telephone equipment in Milan.

Consumption of Meat in Germany before the War.—In 1913, according to some statistics lately published, it appears that the total output of meat from the public slaughter-houses in the whole of the German Empire under government control amounted to 2,634,712,836 kilogrammes (in round numbers upwards of 2½ millions of English tons). The animals slaughtered comprised bullocks, calves, horses, sheep and pigs. Taking the population of Germany at upwards of 67 millions, this quantity would work out at the rate of 39 kilogrammes 378 grammes per head (86·82 lbs.). To this must be added the meat of animals slaughtered privately at farms, etc., estimated at 8·069 kilogrammes (17·8 lbs.) per head, and the proportion due to meat imported in excess of that exported, which is taken at 3 kilogrammes 279 grammes (7·22 lbs.), making a total of 50·721 kilogrammes (111·84 lbs.) per head of population.

The World's Coal in 1912.—According to the Report on Mines and Quarries by the Chief Inspector of Mines, the number of persons engaged in mining and quarrying at home and abroad in 1912 was nearly 6¼ millions, of whom nearly one-fifth were employed in the United Kingdom, and more than one-third in the British Empire. More than half the total number were engaged in getting coal alone, Great Britain employing 1,072,000; the United States nearly 723,000, Germany nearly 719,000, France over 202,000, Russia (1910) over 180,000, Belgium over 146,000, Austria over 128,000, and India nearly 133,000. The total amount of coal produced was nearly 1,250 million metric tons, the value of which is estimated at over £481 millions sterling. The quantity and value compared

with the year 1911 show an increase of over 63 million tons in the output, and of over £46½ millions sterling in the value.

Cultivation by Electricity in Italy.—It is announced that some interesting experiments will be made, during the coming spring, in the application of electric power for ploughing and other agricultural operations in Italy. The trials, which will be made under the auspices of the "Stazione Sperimentale di Risicoltura" of Vercelli, and the "Società anonima Elettricità Alta Italia" of Turin, will take place on a rice farm in the Province of Novara. The trials will be open to foreign as well as Italian makers. A minimum of 5 hectares (about 12½ English acres) is fixed for the ploughing competition. Substantial prizes, as well as payment for the land ploughed, are offered. The rice-growing districts of Vercelli and Novara are particularly well supplied with electric energy, derived from the numerous rivers and torrents which flow in the Italian valleys of the Alps.

Output of Coal in Germany.—According to a telegram from Berlin, published by an Italian paper, it is stated that the total output of coal in the German Empire in 1914 amounted to 84,809,916 tons, or 16·57 per cent. less than during the preceding year. The consumption during the same period was 55,146,642 tons, or 15·49 per cent. less than in 1913. It is also stated that coke is almost exclusively being used on the German railways.

Imports of Flour and Grain to France.—According to the *Journal Officiel*, the quantity of grain imported by France during the four months ending November 30th last amounted to 5,933,162 quintals (504,169 English tons), as compared with 4,723,062 quintals (464,868 tons) during the corresponding period of the previous year. The quantity of flour imported during these four months was 653,509 quintals (64,321 English tons).

Decrease of Trade of Port of Genoa, 1914.—It was stated at the last general meeting of the Port authorities at Genoa that there has been a falling off of upwards of 600,000 tons in the movement of shipping at Genoa last year, as compared with that of 1913. This falling off is chiefly noticeable in the quantity of coal landed, whilst the imports of cotton, on the other hand, show a considerable increase.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock (except where otherwise announced):—

February 24.—W. J. Ashley, M.A., M.Com., Ph.D., Professor of Commerce in the University of Birmingham, "The Economic Position of Germany." The Right Hon. Sir George Houston Reid, G.C.M.G., D.C.L., K.C., High Commissioner for the Commonwealth of Australia, will preside.

March 3, at 4.30 p.m. — William Poel, "Shakespeare's Profession." Sir Squire Bancroft will preside.

March 10.—J. W. Gordon, K.C., "Patent Law Reform and the War." Dugald Clerk, D.Sc., F.R.S., will preside.

March 17. — H. M. Thornton, "The Industrial Uses of Coal Gas."

March 24, at 4.30 p.m.—Lady Lugard, "The Work of the War Refugees' Committee." Colonel Sir Thomas H. Holdich, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Chairman of the Council, will preside.

April 14. — T. Thorne Baker, "The Industrial Uses of Radium."

Indian Section.

Thursday afternoons:—

March 18, at 4.30 p.m. — Lieut.-Colonel A. C. Yate, I.A. (retired), "The Indian Army." The Right Hon. Viscount Bryce, O.M., D.C.L., LL.D., F.R.S., will preside.

April 15, at 5 p.m. — Perceval Landon, "Basra and the Shatt-ul-Arab." The Right Hon. Earl Curzon of Kedleston, G.C.S.I., G.C.I.E., will preside.

May 13, at 4.30 p.m.—M. M. S. Gubbay, I.C.S., "Indian Trade and the War."

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

March 2.—David Lindsay (Leader of the Elder Scientific Exploration Expedition, etc.), "The Northern Territory of Australia: Past, Present, and Future." The Right Hon. Sir George Houston Reid, G.C.M.G., D.C.L., K.C., High Commissioner for the Commonwealth of Australia, will preside.

May 4.—S. Chas. Phillips, M.S.C.I., "The Empire's Resources in Paper-making Materials."

Dates to be hereafter announced:—

Frank Baines, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

E. W. Hulme, "Patent Law."

Roger Fry, "Post Impressionism in Design."

C. H. Sherrill, "Ancient Stained Glass."

A. S. E. Ackermann, B.Sc., Assoc.M.Inst.C.E., "The Utilisation of Solar Energy."

Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

Augustus Vernon Harcourt, D.C.L., LL.D., D.Sc., F.R.S., "On an Economical and Smokeless Grate, and on the Measurement of the Efficiency of Open Grates."

Cantor Lectures.

Monday evenings, at 8 o'clock:—

M. H. Baillie Scott, "House Building—Past and Present." Three Lectures.

March 15, 22, 29.

David Sommerville, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

Fothergill Lectures.

Monday evenings, at 8 o'clock:—

Professor Vivian B. Lewes, F.I.C., F.C.S., "Motor Fuel." Three Lectures.

Syllabus.

Lecture II.—February 22.—*Petrol Substitutes.* (*a*) Definite compounds—Benzol and alcohol. (*b*) Mixtures—How far mixtures of heavier grades of petroleum with spirit can be used. (*c*) The "cracking" of heavier fractions of petroleum into spirit—The researches upon which such processes are based, and their teaching.

Lecture III.—March 1.—"*Cracked*" *Spirits.* The effect of degree of temperature used—The use of water or steam—Surface action and its supposed effect—Processes in use—The utilisation of gases in solution to increase vapour tension—The steam engine *versus* the internal combustion engine for motor traction—Conclusions.

MEETINGS FOR THE ENSUING WEEK.

Monday, February 22...Royal Society of Arts, John-street, Adelphi, W.C., 8 p.m. (Fothergill Lecture.) Professor Vivian B. Lewes, "Motor Fuels." (Lecture II.)

Medicine, Royal Society of, 1, Wimpole-street, W., 8 p.m. Section of Odontology. 1. Dr. Ackerley, (*a*) "Some Primary Factors in the Causation of Gingivitis"; (*b*) "Disappearance of Adeno-Fibroma of Breast after Adequate Treatment of Oral Sepsis." 2. Dr. H. Ewan Waller, "The Influence of the Thyroid Gland upon Dental Caries."

Surveyors' Institution, 12, Great George-street, S.W., 8 p.m. Messrs. I. Dixon and B. H. N. Ryde, "The Report of the Land Enquiry Committee on Rating."

Geographical Society, Burlington-gardens, W., 8.30 p.m. Sir Everard Im Thurn, "European Influence in the Pacific."

Tuesday, February 23...Electrical Engineers, Institution of (Local Section), 17, Albert-square, Manchester, 7.30 p.m. Paper on "Training of the Industrial Side of Engineering."

(Western Local Section.) Park-place, Cardiff, 5 p.m. 1. Address by the Chairman, Mr. D. E. Roberts. 2. Mr. C. P. Sparks, "Electricity Applied to Mining."

Royal Institution, Albemarle-street, W., 3 p.m. Professor C. S. Sherrington, "Muscle in the Service of Nerve." (Lecture VI.)

Civil Engineers, Institution of, Great George-street, S.W., 8 p.m. Mr. H. E. Yerbury, "The Electrolytic Action of Return Currents in Electric Tramways on Gas- and Water-mains; and the Best Means of Providing against Electrical Disturbances."

Zoological Society, Regent's-park, N.W., 8.30 p.m. 1. Miss Jackson, "Exhibition of a Collection of Stick-Insects." 2. Dr. J. F. Gemmill, (*a*) "Abnormal Gills in the Starfish, *Porania pulvillus* O. F. M."; (*b*) "On the Ciliation of Asterids, and on the Question of Ciliary Nutrition in Certain Species." 3. Miss K. Haddon, "On the Methods of Feeding and the Mouth-parts of the Larva of the Glow-worm (*Lampyris noctiluca*)." 4. Mr. R. E. Turner, "Descriptions of New Fossorial Wasps from Australia." 5. Lieut.-Colonel J. M. Fawcett, "Notes on a small Collection of Heterocera made by Mr. W. Feather in British East Africa, 1911-12."

Anthropological Institute and the Prehistoric Society of East Anglia (Joint Meetings), at the Royal College of Surgeons, 2.30 p.m. Papers will be read by Members of the Prehistoric Society.

50, Great Russell-street, W.C., 8.15 p.m. Mr. C. Dawson, "Ouse Valley Cultures."

Wednesday, February 24...Royal Society of Arts, John-street, Adelphi, W.C., 8 p.m. Professor W. J. Ashley, "The Economic Position of Germany."

Geological Society, Burlington House, W., 8 p.m. 1. Dr. J. E. Marr, "The Ashgillian Succession in the Tract to the West of Coniston Lake." 2. Mr. H. S. Shelton, "The Radio-active Methods of Determining Geologic Time."

Electrical Engineers, Institution of (Local Section), Philosophical Hall, Leeds, 7 p.m. Mr. C. P. Sparks, "Electricity applied to Mining."

Literature, Royal Society of, 20, Hanover-square, W., 5 p.m. Mrs. C. C. Stopes, "Hamlet of the Story and Hamlet of the Stage."

Geographical Society, in the Theatre, Burlington-gardens, W., 8.30 p.m. (Extra Meeting.) Sir Harry H. Johnston, "Africa after the War."

Thursday, February 25...Royal Society, Burlington House, W., 4.30 p.m.

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Child Study Society, at the Royal Sanitary Institute, 90, Buckingham Palace-road, S.W., 6 p.m. Discussion on the "Care and Development of the Child—from the Ante-Natal Period to Five Years of Age." "Ante-Natal Period," by Dr. G. E. Pritchard; "Infancy," by Miss J. Halford; "One to Five Years," by Dr. D. Forsyth.

Royal Institution, Albemarle-street, W., 3 p.m. Dr. P. Chalmers Mitchell, "The Struggle of Nations."

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mr. R. A. Morrell, "Three Periods of Warfare."

Electrical Engineers, Institution of, Victoria-embankment, W.C., 8 p.m. Mr. C. P. Sparks, "Electricity applied to Mining."

Friday, February 26...Royal Institution, Albemarle-street, W., 9 p.m. Rev. A. L. Cortie, "The Solar Eclipse of 1914."

Shakespeare Association, King's College, Strand, W.C., 5.30 p.m. Mrs. C. C. Stopes, "Shakespeare and War."

Physical Society, Imperial College of Science, South Kensington, S.W., 5 p.m.

Saturday, February 27...Royal Institution, Albemarle-street, W., 3 p.m. Professor Sir J. J. Thomson, "Recent Researches on Atoms and Ions." (Lecture II.)

Journal of the Royal Society of Arts.

No. 3,249. VOL. LXIII.

FRIDAY, FEBRUARY 26, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MARCH 1st, 8 p.m. (Fothergill Lecture.) PROFESSOR VIVIAN B. LEWES, F.I.C., F.C.S., "Motor Fuel." (Lecture III.)

TUESDAY, MARCH 2nd, 4.30 p.m. (Colonial Section.) DAVID LINDSAY (Leader of the Elder Scientific Exploration Expedition), "The Northern Territory of Australia: Past, Present, and Future." The RIGHT HON. SIR GEORGE HOUSTON REID, G.C.M.G., D.C.L., K.C., High Commissioner for the Commonwealth of Australia, will preside.

WEDNESDAY, MARCH 3rd, 4.30 p.m. (Ordinary Meeting.) WILLIAM POEL, "Shakespeare's Profession." SIR SQUIRE BANCROFT will preside.

Fellows are requested to note that the hour of the Ordinary Meeting on Wednesday next is 4.30 p.m. instead of 8 p.m.

Further particulars of the Society's meetings will be found at the end of this number.

FOTHERGILL LECTURES.

On Monday evening, February 22nd, PROFESSOR VIVIAN B. LEWES, F.I.C., delivered the second lecture of his course on "Motor Fuel."

The lectures will be published in the *Journal* during the summer recess.

CANTOR LECTURES.

The Cantor Lectures on "The History and Practice of the Art of Printing," by R. A. PEDDIE, Librarian of the St. Bride Foundation Typographical Library, have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Royal Society of Arts, John Street, Adelphi, London, W.C.

A full list of the Cantor and Howard Lectures which have been published separately, and are still on sale, can also be obtained on application.

COVERS FOR JOURNALS.

For the convenience of Fellows wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1*s*. 6*d*. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

A meeting of the Indian Section was held on Thursday, February 11th, 1915; LIEUT.-COLONEL SIR FRANCIS E. YOUNGHUSBAND, K.C.I.E., LL.D., D.Sc., in the chair.

THE CHAIRMAN, in introducing the reader of the paper, said he was one of the hundreds of British officers serving on the 3,000 miles of the Indian frontier in extremely varying conditions. In addition to that courage and military training which was to be expected in military officers he also had a very large share of tact, resourcefulness and sympathy in dealing with all kinds of different people—in fact, all those qualities which were so conspicuously absent in our opponents across the North Sea at the present moment. The author served for many years in the Assam Military Police, and in that capacity had exceptional opportunities of becoming acquainted with that extremely interesting piece of country and people which he would describe in the paper. It was a country in which he (the Chairman) personally took very great interest, because he tried, when he was at Lhasa, ten years ago, to send down an expedition to solve the problem of the identity of the Brahmaputra River with the River Tsanpo, which the expedition crossed in Tibet on the way to Lhasa. It was a most remarkable circumstance that that huge river should be able to find its way across that gigantic range of

snowy mountains, the Himalayas, which had recently been proved by the explorations of Captain Bailey, Captain Morshead, and others.

The paper read was —

TRIBES OF THE BRAHMAPUTRA VALLEY.

By Captain Sir George Duff Dunbar, Bt., I.A.

The part of the world that we are going to consider this afternoon is a section of the wild country lying between the Main Snowy Range of the Himalayas and the plains of Assam. Through this region flow two great rivers —the Brahmaputra and the Subansiri. With the Brahmaputra, which is the Tibetan Tsanpo, the Abor Siang, and the Assamese Dihang, the names of Kinthup and of two British officers —Bailey, of the Political Department, and Morshead, of the Survey of India—are indissolubly connected.

There is barely time to describe the country, and run quite briefly over some of the more salient characteristics of the Abors and Galongs, two of the tribes settled in the highlands drained by the Dihang; but it should be realised that to east and west in very similar country dwell other peoples, probably of the same stock, who are either, as the Akas, in a more advanced state of civilisation, or, like the Mishmis, in a yet lower grade of culture.

The country rises in a series of ridges from the plains. Behind the foothills Nature has flung a tangle of high jungle-clad spurs, with a corresponding labyrinth of deep-cut valleys beneath them. The foothills of clay and shale that make none too easy going are, of course, entirely dwarfed by the country immediately south of the high snowy peaks that guard the passes into Tibet. Anyone who has seen this region can whole-heartedly apply to it Service's lines upon the Yukon :—

It's the cussedest land I know,
From the big dizzy mountains that screen it
To the deep death-like valleys below.

But between the clay slides and razor edges of the foothills and the tremendous cliffs and cañons to the north lies a most welcome intermediate zone. Here, in the heart of the hills, the spurs recede and the country becomes more open. The alluvial terraces that mark earlier levels of the Dihang and the rich straths up the Siom river are industriously cultivated and support large groups of prosperous communities. Similar conditions exist in the Dafla country. The Mishmi highlands do not improve in the same way on a closer acquaintance.

The two principal points that strike the traveller are the extraordinary closeness and luxuriant growth of the jungle that stifles the whole country, and the unpleasant fact that the miles stand almost on end. A normal road section looks like a bad enteric fever chart. When one has got into sufficient training to be able to admire the view from the crest of a ridge or at a clearing, another feature becomes evident. This is the stupendous depth to which the Dihang river has cut its bed (it is sometimes three thousand feet below the path) and the remarkable twists it makes in its course through the hills. There is one place where it changes its direction to every point of the compass in a space of under six miles. One remembers the mighty river best as a great grey-green snake, flecked with the foam of its rapids, writhing between great walls of rock on its long journey from Western Tibet to the Bay of Bengal; and, if I may say so, worst as the rather turbulent carrier in flood-time of a badly waterlogged bamboo raft. This perhaps is ungrateful, as the mahseer and boka that swarm in its water give the most excellent sport.

The magnificent pine lumber that is swept down the river comes from Tibet itself, or from the country immediately below the Main Snowy Range. Up the main valley, even on the highest features, we found no pines, cypresses or tree azaleas and rhododendrons much south of the twenty-ninth parallel of north latitude. Yet immediately to the east, in the Mishmi country, the first march out of the plains brings one to the azalea and rhododendron forests, and the pines come down almost, but of course not quite, as far south.

The forests of the Abor country vary, naturally, in character according to their height above sea-level. This can best be illustrated by some notes made on the ascent, at the end of May, of a ten thousand foot hill on the twenty-ninth parallel. The hill, locally known as Dino, was an isolated feature rising above the Dihang, in a perfectly symmetrical cone, and ridiculously easy to climb.

A shot at a takin on the higher slopes and the prospect of a wonderful view from the summit were hopefully anticipated. The entire absence of water for the last five or six thousand feet precluded all chance of big game, and a persistent drizzle and sleet while the party remained at the top prevented an

enjoyment of any more view than that of wet and icy-cold shelters of pine-branches under the lea of limestone slabs, varied by an inspection of the patches of snow that yielded our only water supply.

But to return to the climb. The zones of vegetation were in clearly marked belts. To nearly four thousand feet thick luxuriant undergrowth and parasitic jungle choked the forest, then came brakes of thin bamboo and low bush jungle at the foot of the trees. This was succeeded by ferns and the stony outcrop became more noticeable. All Dino is a whitish crystalline limestone. The trees, too, had changed their character and we were among the azaleas, then in bloom, immense blossoms of white filling all the air with fragrance. Above these again the rhododendrons began—first the red, then an occasional tree dotted with little bunches of clear pink flowers. Most of the tree-trunks were quite bare, the azalea stems a rusty brown, making a fine colour effect. At eight thousand four hundred feet we found the first cypresses, and the rhododendrons—some of them—had yellow blossoms. We saw trees with leaves a cross between the foliage of the elephant apple and the true rhododendron all in flower, with bunches of white canterbury bells. At this height the trees were coated with thick moss. At nine thousand feet, climbing over great square blocks of limestone, we came across a bush or two of holly among the cypresses. Then a final scramble brought us up on to the summit. A narrow heath-covered ridge, strewn with limestone slabs, and dotted with low scrubby rhododendron bushes and azaleas all purple or pink, then in flower, dwarf cypresses with torn branches, and flat-topped as if shaved by the tremendous winds. The lower forests are bright with orchids that cling, like the ferns, to the tree-trunks, but here at more than ten thousand feet we found Sylogyne, hardiest of all orchids, for it must spend more than half its life under the snow.

In the lower forests clumps of bamboo and wild plantain are prominent features. The undergrowth includes highly poisonous stinging shrubs and nettle and a very thorny cane that we call "baint." In marked distinction to the country to the east and west, there is very little game in the Dihang valley. The lower zones are overhunted. There are a few serow and an occasional tiger; khalij pheasants, jungle-fowl and hill partridges are not uncommon. The country makes up for all this by harbouring the hosts of leeches, poisonous flies, mosquitoes and ticks that rejoice in a rainfall estimated at about 800 inches in the year.

So much for the country. We may now consider the people settled there.

The type is distinctly Mongoloid. It might be rash to claim kinship for them with the nomad totemistic tribes of Central Asia, such as the Yakuts, but systematic investigation for over four years has led me to the conclusion that the Abors and their brethren migrated from the Tibetan side of the Himalayas into the Dihang valley. Writing is unknown, so ancient inscriptions do not exist, but such myths as survive amongst the village medicine-men all point to a northern origin. Successive waves of migration seem to have pushed the earlier settlers south and then west. So we now find the Abors and Membas (or Monbas), who came last of all, in possession of the valley, with the Galongs, Hill Miris and Daflas away to the west. The Membas, we know, came over about a hundred years ago, and founded their colonies by ousting the wild Tangam clan of Abors, then established north of the twenty-ninth parallel, from the most fertile portions of what is now known as Pemakoichen. Similar Memba migrations in recent times have occurred further to the west.

Only those hillmen who are in touch with Assam recognize themselves as "Abors." This name is derived from the Assamese *a-bori*, unfriendly, which clearly indicates a reputation won from the seventeenth century onwards by incessant raids and forays. They will admit to belonging to a clan, such as Minyong or Padam, but prefer to call themselves men of their own village, or of its parent community. The village is the true political unit, but even here the different septs that live in it do not always have community of interests. One of the reasons for so parochial an outlook is to be found in the extravagant method of cultivation employed by the hillmen that obliges all villages, other than the prosperous allied groups in the richest localities, to establish themselves at a considerable distance from each other.

Till the close of the eighteenth century all the tribes west from the Aka country to the Dihang were grouped together by the Assamese Government under the name of Daflas. They are all definitely akin, in their ways and general appearance. Nor, apart from the distinctive dialects spoken in the Dihang valley, is there much essential difference in their language. It is interesting to note that the Limbus of Nepal, from whom we draw some of our sturdiest recruits for the Military Police, have much in

common in religion and even in language with the Abors.

Photographs give the best idea of the appearance of the people. As their complexion varies, from a very dark brown near Assam, to almost white high up the valley, and as some clans, such as the Padam Abors and Memong Galongs, are frequently of an unusual height for hillmen, it is difficult to generalise in describing them. But one can say—generally—that they are a sturdy race, with straight black hair and dark brown eyes. Infanticide has never been admitted to me, but on only one occasion (if I exclude a headman with six toes) have I come across any deformities. These were two women dwarfs in Membu, a Padam village, both of whom were fully developed and healthy.

There are among the more southern clans two methods of hair-dressing. The typical Abor cut for both sexes is to shave all round the lower part of the skull, leaving a thick cap on the top of the head with a straight-cut edge above the ears. The Galong men generally cut their hair more or less short all over, while their women part theirs in the middle, and tie it in a bun at the back, plaiting the tresses nearest the forehead. This is similar to the way in which some Kongbo women whom we met did their hair. The wildest hillmen we saw wore their hair quite long and loose.

There is not time to give details of their clothing. To take the men first: it ranges from the grass sporan, that is frequently deemed sufficient on a wet and muggy day, to thick woollen chocolate-coloured coats and skins of deer or takin. All the woollen stuffs are imported from Tibet. Cotton fields were seen the whole way up the Dihang, and the cloth made from this is dyed black by the northern clans; it is left white in the southern districts. The thicker skirt-cloths that the women wear are woven in blue, red, white, green and sometimes yellow, by the communities closest to the plains. The men of one clan almost universally wear an excellent short coat of what looks like blue serge. One article of dress remains constant, the "bowler"-shaped hat, generally of fine cane-work, but sometimes of hide. This is gaudily bedecked with bunches of hair dyed red, feathers, or hornbill beaks, according to the wearer's fancy.

Little boys and youths frequently go about in a state of nature. Little girls always wear a disc or two as a beyop. The beyop is a girdle of a varying number of white metal discs (they are rarely of brass) of graduated sizes, that is worn exclusively by Abor and Galong girls until the birth of their first child. The legend of its origin, the gift of a god, recalls certain tales of Greek mythology.

It is curious that among the Hill Miris and Daflas, who are almost identical in appearance, language, customs and beliefs with their eastern neighbours, the beyop is unknown. Their more well-to-do women wear over their short skirts a cane or leather belt adorned with rather elaborate metal bosses.

You can see from this photograph how the beyop is worn. The number of discs varies in the different clans. The Minyong young women jangle to the tune of as many as thirteen in their walks abroad, but eleven or nine is more usual. Galong women generally wear fewer discs than this. In the north five, and amongst the wilder clans (where metal is scarcer) three discs serve their less exacting needs. In the more remote districts especially, the beyop is in summer not uncommonly the only wear.

Apart from this, the costume of the ladies has been seen to range from the Arcadian simplicity of a skirt of leaves to a couple of gaily-coloured cloths, one worn as a petticoat, the other wound tightly round the upper part of the body. In very wet weather they may throw a small cloth over their heads, but no women have ever been seen wearing the cane hat, which is in fact an article of kit for the fighting man.

In the way of ornaments both men and women wear strings of blue or green porcelain beads. Some of these necklaces contain bits of shell, or metal-work, from Tibet. The best necklaces are handed down as heirlooms, and are of considerable age. Earrings of white metal or bamboo are worn by men and women alike. Both sexes wear rings of cane round their legs below the knee, and plaited cane belts that are occasionally worked in neat conventional designs, in white and black. Abor women wear anklets of plaited cane-work bands. Galong women wear broad, flat bands of brass round the ankles. These are put on in childhood, and are not taken off again, except as a mark of disgrace. The Galong matron consequently regards her hideously misshapen leg with equanimity, and will endure considerable pain from an over-tight anklet with composure.

Cicatrisation is unknown. Only some of the tribes tattoo. This is, moreover, a decaying practice, and is chiefly followed by the women. Skilled artists in tattooing, if one can apply the term to a people almost entirely devoid of the artistic sense, are given a definite wage, either

in kind or in labour. The designs, which take the form of lines, circles, and crosses on the mouth, cheeks and forehead, and something like the hieroglyph for the Nile on the calves of the leg, are made in charcoal with a sharp bamboo needle.

On a journey the hillman wears a big ruksack with, as a rule, a rainproof, fibrous cover, generally dyed black. In this he carries his food supplies of rice tied up in packets of leaves, a meal in each. Smoked birds, bits of squirrel or rat on skewers, and such small deer are taken as delicacies, and chillies and perhaps ginger to vary the monotony of his boiled rice. In the Mishmi hills millet—not rice—is the staple food. His pipe and tobacco are carried, like his quartz and steel (flint is unknown in his hills) in pouches of skin that he hangs about him. He is never separated from his *dao*, which is the broad-bladed dirk indispensable to the wild man of the woods. Generally he has a bamboo staff, and invariably he slouches along, puffing his acrid tobacco, with his dog somewhere on ahead. Abor dogs are usually black with points, and look like badly-bred terriers. We must remember, as the hillman invariably does, a bamboo cylinder or gourd full of *apong*, as he calls his beer. It is a mild intoxicant brewed from millet seed. Every hillman, and woman and child, too, is frequently "disposed" to put the gourd to his lips, and expects all friendly white visitors to do the same. I may say here and now that the stuff varies from the quality of quite a good hock to the depths of nauseousness. On a hot day, after the usual stiff climb to a village, it can be most welcome, even from its forbidding receptacle—a pipe-shaped gourd dipped many times and oft, for all and sundry, into the large gourd that holds the brew.

There are two types of village. This photograph of Kombong, a Galong village, shows the haphazard way in which the houses of one type are built. In Minyong Abor villages each sept builds its houses in a continuous line. This is Komsing village, and the excellent photograph was taken and given to me by Mr. Stanley Kemp, of the Indian Museum, who accompanied the Abor Expedition of 1911–12. It was in this village that Mr. Noel Williamson and his party were massacred in the spring of 1911. Villages are, as a rule, perched on a ridge or plateau some little way from their fields. The approach to the village along a sharply ascending path is marked by an arch or gateway, flanked on either side by the rather poor defences afforded by a palisade or low stone wall. Sometimes visitors find a succession of newly-made archways of green boughs and plantain stems over the path. These are not triumphal arches erected by an enthusiastic entertainment committee in honour of the representatives of His Majesty's Government. They are put up by a superstitious community, who devoutly hope that even if they are unable to evade a highly undesirable visitation, they can at least make arrangements to exclude the still more distressing demons of ill-luck and disease that always accompany strangers from afar. So these arches bristle with imitation arrows and *chevaux de frise*, and on them are skewered sacrifices of dismembered dog, pig, or even cattle, according to the custom of the clan and wealth of the community. Nor, on the other hand, should the traveller place a false construction upon the volley of bits of plantain stalk that may follow up his departure from the village. These are thrown to drive out any malevolent spirits that may have penetrated the defences when the party arrived.

Within the bounds of the village, and well below it, is the burial ground, a cluster of tiny huts that are built over the graves.

The immediate vicinity of the village is proclaimed by the barking of many dogs, the shouts of the inhabitants, and the glimpses of the thatched roofs of the granaries among the jack-trees that the hillman so carefully tends. By this time, of course, the party has been met by a solemn deputation of all the most prominent citizens, attended by their womenkind with the inevitable gourds of *apong*. They also bring little baskets of doubtful eggs and very skinny and ancient fowls—the customary offering to evil spirits.

All hill houses are raised off the ground on piles or, in the north, stone walls. They are plank or bamboo-built structures with open platforms in front of the main entrance. The roof is thatched with cane leaf that lasts about three years. There are no windows, and the roof comes down very low, to keep the rain from driving through the walls. The houses vary enormously in length. A Mishmi house, built to accommodate perhaps a dozen families, is over one hundred yards long, and is divided up into regular suites of apartments. The Subansiri hill houses are not as long as this; they shelter, perhaps, two or three families. The squat Abor and Galong dwellings are built for a single household, not infrequently as a sort of wedding present from the village to a newly-married pair.

In Abor and Galong houses the one big room

is about 30 ft. long by 24 ft. wide, lit up by the fire flickering on its square stone hearth—and ventilated not at all. The portable possessions of the household are kept on a large tray that hangs from the rafters. The master of the house sleeps near the door, and the rest of the family keep on the further side of the fire. Trophies of the chase and menus of bygone banquets, in the form of heads of cattle, hang on the walls. I have been entertained, in a Naga house, where the heads were of a much more interesting kind—but that is a story of another frontier altogether.

Besides the family dwellings two other buildings are to be seen in an Abor village. The most important of these is the Moshup, a long building with many entrances that is both the village council chamber and the barrack in which the young men of the village sleep at night. It is generally in a central position. The other building, which is not always to be found in their villages, is a dormitory for the unmarried girls.

The smith works with his bamboo bellows and his clay and wax moulds in his own house. Industrious families are to be seen cleaning and spinning cotton, or weaving, or, perhaps, making basket-work of cane, or mats of screw-pine leaves on the platforms of their houses; whilst the old men, clad in their fluffy cotton coats, sit about and smoke and grumble—as they do in other places. Sugar-cane and other little luxuries (that include opium in the southern hills) are grown in small walled or fenced plots. Jack-fruit and orange-trees abound in the lower villages, and further north we find peach-trees. On the outskirts of the village are the granaries, like miniature houses, and all provided at the top of their supporting piles with wooden discs to keep out the rats.

The water supply is run into the village from the nearest perennial spring. In this, and in his bridges over the larger rivers, the hillman displays engineering ability of a high order. Bamboo aqueducts entailing a skilful alignment are common throughout the hills; but the Padam Abors seem to delight in building their villages on sites as remote as possible from water. Membu, in the foothills, is an excellent example. The spring supplying this large community is tapped on the face of a cliff more than 100 ft. above the level of the main groups of houses. Down the face of this cliff the water is run through two carefully graded spiral pipes. From there the aqueduct runs for 1,200 yards to the village green.

It is not possible to imagine a more democratic organisation than the system followed by these hill tribes. In the first place the village, and not the clan, is the unit. The headship of the village is not hereditary; and the headman himself only remains the leader of thought and action so long as he voices the feelings of the majority in the rather noisy meetings that are held in the Moshup. Occasionally, of course, a man of very strong personality is able to control his own community and exercise considerable influence over the neighbouring villages.

A far more retiring individual—from the gaze of inquisitive foreigners—is the medicine man or woman (for priestesses are not uncommon among the Abors). The Galong priesthood is only open to men. The mirü, as he is called, by performing the rites of sacrifice and divination exercises a considerable influence and, unlike the headman, is not liable to supersession. He is therefore a power in the village. The Galong mirüs, moreover, are believed to possess powers of an unusual kind. The most formidable of these is an ability to curse his enemies to death from a lofty platform.

The cultivation of corn in sufficient crops, in the wild jungle-clad hills that these people inhabit, is a problem that entails immense labour. This problem is rather unsatisfactorily solved by a system of agriculture known as jhuming. Large tracts, within the recognised area owned by the village, are cleared, and the felled wood and undergrowth burnt. These cleared tracts are divided up among the different households, who proceed to sow rice and millet broadcast over their holdings. There are two harvests, one in May, the other in September. Wet rice cultivation is unknown. Chillies, tobacco, cotton, Indian corn, pumpkins and cucumber are also grown. But in so wet a climate weeds, grasses, bushes and saplings grow apace, and after three or perhaps four years the villagers give up the unequal contest with nature and seek fresh woods to turn into pastures new. They may perhaps return to the same ground in fifteen or twenty years, but the system is a wasteful one and demands a wide range of country. This keeps the villages rather far apart, and appears at least to contribute to the isolated policy and lack of cohesion noticeable through the hills. Exceptions are found in the highly cultivated and densely populated straths of the richer valleys. But everywhere the methods are primitive, and a dao and a pointed stick are the only agricultural implements they

know. The hills are cultivated up to a height of about 5,000 ft.

The most important live stock are the herds of domesticated mithan (*Bos frontalis*). These belong to definite households. The various septs mark their cattle by cutting oblongs and triangles out of their ears. Mithan are not milked and are only killed for ceremonial feasts. This is done by strangulation with a rope. A pig is strangled between two sticks and a bamboo skewer run through its heart. Pigs and fowls are fairly plentiful. Goats are found in the Galong country, but are not kept by the Abors. The hillmen eat eggs. As a matter of fact, to eke out indifferent harvests they ransack the streams and the woods for fungi, insects of the beetle and locust families, prawns, birds, and rats. In the rivers huge fish traps are set. These are either baskets tied on long cane ropes to the end of bamboos, or dams built out across the river. The fungi are boiled several times as a precautionary measure. Many of the insects are eaten raw. Birds and bits of meat are thrust on to a skewer and either burnt for a little or smoked. Rice is boiled rather neatly. An internode of bamboo is filled with water. Rice done up in packets of leaves is put into the cylinder which is then rested over a brisk fire. The bamboo is turned at intervals, and when the sides are charred all round the rice inside is found to be cooked.

The people are keen hunters and trappers. Game is driven and shot with poisoned arrows. Many kinds of traps are used, from the formidable bow and javelin contrivance with its trip-wire to release the spring, and the staked pit for the larger animals, down to the stone, supported on sticks under which they catch rats.

The tribes are by nature unwarlike. Individually they can be brave enough, but lack of cohesion reduces their operations to raids and the most minor of onfalls. Like all primitive hunting races, all the male element of the population carry a bow, spears, and perhaps a long sword in addition to their dao, which is an absolute necessity of life to the dweller in the jungle. And all boys are taught to shoot with the bow. Guns are very uncommon, though an occasional tower musket is to be found in the lower villages. In the northern villages prong guns are not quite so rare. The long swords are brought down from Tibet, along the salt trade routes.

The chief weapon is the iron-shod bamboo bow with a cane string. This is effective with all-bamboo arrows up to 180 yards, and I have known it carry 250 yards. The bamboo point is hardened in the fire, and may be dipped in aconite or croton poison. The war arrow, which has a heavily poisoned iron or bone head, has a much shorter range. The shaft is deeply notched so that the head may break off and remain in the wound. All their arrows are fletched straight—not spirally—with cane leaf. The arrows are carried in a bamboo case provided with a lid and fitted with an outside pocket for spare strings and a bracer guard of cane.

Their long spears are more for show, or use as an alpine stock, than anything else; and, unlike the Naga javelins, are never thrown. The spear-head is small and is ornamented with a tuft of hair, dyed red.

When fighting against British troops great reliance is placed on immense and elaborately built stockades. One of these was found by a punitive column to be 2,000 yards long, 10 ft. high, loopholed and shell proof. These stockades are admirably sited. Their engineering skill is also devoted to the construction of stone shoots. These are generally suspended high above the path—at a ticklish place for choice—and are given a clear line of descent. Those placed 40 to 100 ft. up are the most awkward for a shower of rocks bounding down a steep hillside from 1,000 ft. up may look formidable, but is almost certain to miss the roadway altogether. When inter-clan differences are being settled cut bridges and blocked roads play a prominent part.

Reference has been made to the industry and engineering skill of the people. These qualities are combined in the construction of the tubular cane bridges with which they span the Dihang.

This bridge (below Komsing) has been destroyed since these photographs were taken by Mr. Kemp. But there are quite a number of similar feats of engineering higher up the river. This particular bridge was built in about three weeks. It was 786 ft. long and was at the entrances 130 ft., and in the centre 50 ft. above the winter level of the river. In the construction of these bridges several strands are floated across, pulled taut on the trees selected on either bank as uprights; and on this the bridge is made. They are very flimsy, have frequently no semblance of a roadway and swing most unpleasantly in a wind. The Abors always cross these bridges in step, singing as they go.

It has already been observed that writing is unknown. This is accounted for by the Padam Abors in a rather curious legend. Long ago, the story runs, the Supreme Being gave his

precepts to man. To the cities of the plains he gave tables of stone, to the people of the hills he gave a sheet of parchment. But with characteristic improvidence the hillman, to whom the precious skin was entrusted, being sorely pressed by hunger, ate it.

To supply the lack of writing, messages of the greatest importance are occasionally sent in the form of stones, rice, chillies or charcoal tied up in small baskets. These messages seem to be confined to protestations of friendship or cartels of defiance.

Chillies and charcoal mean the absolute defiance of a mind burnt like charcoal, with thoughts as fiery as the chillies accompanying it. An embassy was once sent to us by a hill community to proclaim its peaceful intentions. These, I may say, were found afterwards to be sincere, though they were doubted at the time. The spokesman produced a bag and drew from it a sword-blade bent double. "This," he said, "is the sentiment of the Gam towards the Government; and this (producing a spear-head, with a broken point) is the sentiment of his kinsman and co-Gam. This (producing a round pebble in a cane-work basket) is the heart of these two, which they send clean of reproach. This (producing an old metal charm), being made from an element of the earth, bears witness to the straightness and truth of the mind and words of the Gam and his kinsman."

As a warning to cattle thieves, "signboards" are erected on the path from the offender's village. They are made of cane and bamboo. A stick represents the thief, who is exhibited in a miniature stock—the ultimate fate of the cattle thieves. The signboard is studded with a number of slips of bamboo representing arrows to indicate the feelings of the aggrieved owner of the stolen animal.

There is no time to touch even briefly upon the question of language. But there is, I understand, some similarity between the form of numerical adjectives used by the Abors and the Burmese. Notation is very simple, in tens, ten and one, and so on, up to 100. But the hillman's ideas of the higher numbers are exceedingly vague. He likes to be able to count upon his fingers and toes, or else to produce little bundles of sticks.

The Galongs and Abors are exogamous, and intermarriage between members of the same sept is tabu. Polyandry is unknown. Polygamy occurs only when the head of the house is well enough off to acquire more than one wife. The men make really good husbands, and prior to marriage and the setting up of a house of their own, court the girl who takes their fancy. The Abor lady wears as an engagement ring a loop of cane suspended from her neck. Sometimes a ring is broken and each keeps half. The young man is expected to give occasional presents of squirrel skins to the girl's parents, and has to pay them a varying number of mithan when he takes her away from her father's house.

The present religion of the hillmen is polydemonism. The tribes propitiate the malevolent spirits of earth, air and water by varying rites, and call them by different names. Sacrifice of animals and libations of apong are held to appease these demons when sickness and death manifest their displeasure. For instance, if, when the jungle is being cleared for cultivation, anyone falls sick, it is attributed to the anger of the local demon at the destruction of his home, and propitiation is offered, generally by sacrificing a pig. Time will, I think, just permit me to describe the rites performed during the illness of a woman. A large pig is sacrificed in the village to the angry spirit held to be responsible. The second act takes place in the jungle. Here an altar, consisting of two upright poles connected by horizontal bars, is erected. To this altar is tied a basket containing nuts and plantain and bamboo-leaves. The party making the sacrifice bring a black hen with them; to one of its legs are fastened threads of different colours, and to its other leg is bound the leaf of a certain jungle plant. The hen is then thrust through the bars of the altar and allowed to escape into the jungle. As it is let free the following words are pronounced: "O Nipong, I have marked and dedicated this hen for you. Take it and cure the sick one." If the hen comes back the omens are unfavourable. After releasing the hen a dog is killed and the carcass suspended from the top bar of the altar. The spirit of this animal is formally handed over to the demon, a shield of leaves is placed over it, and the party go home to await the omen of the fowl. I think one of the most interesting features of their religion is a firm belief in the future life of both men and animals.

Sometimes in sickness branches are waved about or stuck into the ground round the sick man's house. At other times the medicine-man organises religious dances by the girls of the village.

Sacrificial rites are observed both at seed-time and harvest, when pigs and fowls are killed and altars are set up.

Throughout the hills a tree, known as the holok, is regarded as the abode of the Wood Spirit. This demon is believed to assume human shape, and appearing in the form of a kinsman from some distant village lures some unfortunate villager away into the jungle. So when anyone is missing and cannot be accounted for, the people of the village go out into the jungle armed with swords, bows and arrows to look for him. They go to the holok tree and say: "O Holok tree, give us back our brother and we will make you a sacrifice." And then, to compel the holok tree to urge the spirit that dwells within it to restore its victim, they hack at the tree with their swords and shoot arrows into its limbs. They then go home and await the return of the wanderer. Hope is not abandoned for about two months. If the man comes back a mithan or pig is killed and eaten at a sacrificial feast.

When a death occurs a maximum of three days elapses before burial, and a ten days' tabu is observed by the household. A grave is dug and lined with branches. In it is placed a platform, and on this platform the corpse is laid, knees drawn up to its chin, and the hands on its breast. Generally there is a pent roof over the body, and on this the earth is thrown. The body is provided with a grave cloth, a porcelain bead necklace, and a brass plate or pot. A little hut is built over the grave, and in this a fire is lit and kept burning for a period that varies from three months up to a little over a year. Apong and rice are left at the hut. On the hut itself, or on a fence erected close to it, are hung the weapons of the dead man, and perhaps some heads of mithan and serow, or, in the north, takin. I have seen in certain tribes gourds hanging to represent the heads of the men a dead warrior has killed in fight, and this is the nearest approach to the exhibitions of the head-hunting Nagas that have been noticed in these hills.

From fragments of mythology that have been collected, it is gathered that the gods were not consistently malevolent, and there still exists a vague belief in an all-great and all-loving deity: but the dominating belief is in the existence of an unseen world inhabited by the malevolent spirits of nature. The souls of all human beings and animals go to the demons who deprived them of life. When animals are sacrificed their spirits go to the deity to whom they are devoted, but the cattle and pig killed during the funeral ceremonies are believed to accompany their owner, and it is for his use that his weapons, cooking utensils and some food are placed beside his grave. It seems, tacitly, to attribute life on another plane to his inanimate possessions. Other races, from ancient Egypt to the Red Indians of the present day, afford parallel examples.

The Galongs stated that if anyone who is dead is seen in a dream, it is believed that the soul has left the companionship of the spirit who deprived its earthly body of life, and has migrated to some other spirit. It is not clear whether this mutation brings the soul into the presence of the shadowy Supreme Being. It is, however, evident that the doctrine of re-incarnation is unknown.

The religious beliefs of the Abors, especially in the north, to some extent betray points of similarity with the religion of the Membas of Pemakoichen. I speak subject to correction, but I gathered, in the course of a visit to that district, that the fundamental idea in each case was the propitiation, through fear, of malevolent spirits. The features of Shukia Thoba and his attendant satellites in the Lamaserais were simply devilish, and the monks extort as much wealth as they can in money and kind by working on the superstitious fears of the country-side. Of course, occasionally, as at Marpung (where Kinthup was befriended by the late Abbot), Sakya Muni sits, a shining golden Buddha with his calm peaceful face, but the main difference seemed to lie in the fact that the Memba religion was overlaid with such ritual and accessories as wealth and a certain amount of culture could give, whilst amongst the Abors it was not. Setting aside the wild Abors of the Tangam clan, who inhabit the more inhospitable parts of Pemakoichen, it may not, perhaps, be out of place to touch briefly on such religious customs of the Angong Abors that can be traced to the influence of their Memba neighbours. Some of these customs are to be found further south. Near one village we saw a large stone covered all over with triangular plaited cane mats, distinctly resembling the images of Buddha that are plastered over the rocks further north. Like the Memba, the Abor believes in the efficacy of boughs planted round a house in time of sickness. In one Memba village high stout posts, connected by long cane ropes, were identified with the worship of the Tibetan diety, Lhamsal. Similar manifestations of piety were seen in several Angong villages. In Janbo village rudely-made figures were fastened to the tops of masts, a feature that may be compared with the worship of the Bhotia god, Dhurma. This had its counterpart

in a most realistic scarecrow seen outside one Memba village, and overlooking the Tsanpo more than 2,000 ft. below. It had been given black clothes and provided with a bow and arrows. This, we were told, was to guard the community against the river god—a distinct echo of the Abor folklore far down the valley. In cases of sickness the Galongs set up an image in the supposed likeness of their most powerful deity. This image is about 4 ft. high, and is made of leaves on a bamboo framework. It is given a cane helmet, and leaves are arranged to represent clothing.

Attention might, perhaps, be drawn to the fact that both Abors and Tibetans strangle the cattle they sacrifice. There is also some resemblance between certain Mishmi and Abor dances and the accounts I have read of the Lama dances. I did not myself do more than see the devil masks of *papier maché* with their tiaras of miniature skulls that are sometimes used on these occasions.

Save for the fact that a regular import trade in woollen coats, salt, *dankis*, and other Tibetan metal-work comes down through Bori and Memba intermediaries to the Galongs and Abors, Tibet exercises no influence, direct or indirect, upon the country under discussion. Travellers are not encouraged, as Kinthup discovered thirty years ago. Abors from the upper part of the valley are at times employed as coolies in the caravans that cross the main passes, but general intercourse between the different Abor clans is so slight that the lower Abors know nothing whatever about the country higher up. We consequently heard some wonderful travellers' tales from the Abors living near the plains. I noted these at the time, and it was interesting, later on, to see in what way they had originated.

We were told that the upper part of the main valley was inhabited by savages, with heads growing straight from their shoulders, who were consequently unable to look up (unless apparently they lay down on their backs). To this fortunate circumstance was attributed the escape of the daring adventurer among them who lived to tell the tale. It was gravely asserted that he climbed up a tree to evade his neckless enemies, and subsequently escaped. We found that the Tangam people below the great gorge of the Tsanpo are afflicted with appalling goitre, and that their appearance:

Dew-lapped like bulls, whose throats had hanging at them
Wallets of flesh,

may well have given rise to this quaintly mediæval story.

Another tale of a fortunately unknown race, called Mimat, described how they existed in bleak wind-swept caves upon the flesh of men. But the "anthropophagi that each other eat" turned out to be Tibetans; their caves were the rest house caverns found on the routes over the high passes, and the charge of cannibalism was due to a most erroneous impression of their own, or *Lepcha*, funeral ceremonies. As a matter of fact, in accusing their unknown neighbours to the north of cannibalism, the Abors err in good company. The charge is as old as the thirteenth century writings of the Franciscan missionaries, and as new as the travels of Sarat Chandra Das.

Abor folklore is not easy to collect. The medicine men who keep the myths alive are distinctly reticent, but from such tales as have been collected one or two examples may be of interest. And with these I will end my paper.

At the beginning of time gods and men lived together upon the earth. And there fell a great distress upon all, because there was no water, and gods and men alike were lean and thin. But it was noticed, with much wonder, that the rat was always sleek and fat. So one day a man followed the rat and tracked it to a big stone, under which it disappeared. When it came out again it was all wet with water, and visibly refreshed. So the man went back and told what he had seen. But when the men came with such tools as they could gather to break the stone and get the water for themselves, they found that it was too hard—so hard, indeed, that it broke the tools they had brought with them. Then the god Debo Kombu took his bow and shot at the stone with an arrow, and a trickle of water, the stream of the arrow, came welling out of the rock. And that is the reason why Debo Kombu is worshipped with his bow and his arrow to this day. But only a tiny flow of water ran out of the stone. So the god Nurupur took an axe and broke the stone, and the water gushed out freely over the thirsty earth. And he, too, is worshipped for ever in the water he gave to gods and men. The interest of this myth lies in the portrayal of conditions so utterly different to the country the Abors now inhabit—where countless streams and a stupendous rainfall are the most prominent features.

Once upon a time Fire fought Water. And all things growing in the jungle, green things to whom water was life, helped Water. So the water rose steadily out of its bed in the valley

below and followed Fire up and up the mountain side. And it rose and rose and covered all the low hills, and filled all the valleys. So Fire fled up to the top of the highest mountain, and there it flickered, for it could go no further. At last the Water was lapping the topmost peak, to which Fire had sprung. Then, just as Water began to break over the very top of the mountain, and it seemed as if Fire must be quenched for ever, it darted as a last refuge into the heart of a stone, and has lived there ever since to be at all times the servant of man. And then Water sank and sank down to its bed once more.

Now, in those early days, the world was scorched by two suns and everything was burnt up, and the fields were hard and dry and the harvests miserable and scanty. So all the people in their distress cried out for someone to lessen the fiery heat. Then the archer-god took his bow and bent it mightily, and sped an arrow into the eye of one of the flaming suns. So the wounded sun died and became quite cold, but it still gives light, and we call it the moon. And the splinters that the arrow made when it struck the sun flew out all over the heavens and became the stars. This is the Abor legend.

The Galong myth tells us of only one sun that was hit by the archer-god, which went and hid under the earth. And the land was plunged into darkness, and a great fear fell upon all. So men went to ask the sun to appear again. But the sun was angry and remained hidden below the earth. Now there was a bird with a long tail perching on the sun, as he lay sulking just below the rim of the world, and the bird talked with the men. When the sun heard the talking he called out and asked who it was, and, out of curiosity, rose to look. And he saw the men who had come to petition him sitting on the ground, and they implored him to return and shed his light over the world. After a little while the sun spoke and said, "If you will give me a daughter of the gods to eat, then I will return and lighten the earth." The men agreed and went back to their homes, but the Bat (who always plays the part of messenger in the myths) followed them and said, "It is a daughter of men that the sun wants, not a daughter of the gods." So the men took one of their daughters and brought her to the sun as a sacrifice; and he devoured her and arose in his strength to give light and warmth to the world. But from that day death has come into the world to destroy the children of men; for, before that, they, like the gods, were immortal.

DISCUSSION.

The Chairman (Lieut.-Colonel Sir Francis Younghusband, K.C.I.E., LL.D., D.Sc.) said the paper was so packed full of information that it was rather difficult to select subjects upon which specially to speak. People in London had to remember the very difficult conditions in which the people described in the paper lived. Their environment in London was almost entirely human, whereas the environment and surroundings of the people who inhabited the Brahmaputra Valley were almost entirely of Nature. In London they lived in the midst of several millions of people amidst the handiwork of men — roads, buildings, modes of traffic, all of human agency. The Abors, on the contrary, lived amongst very few men: in fact, he doubted if any Abor saw more than two or three thousand other human beings in the whole course of his life, and his intercourse with people other than those of his particular tribe was extremely limited. On the other hand, they were incessantly in contact with Nature on a most colossal scale. They lived under the shadow of the greatest mountains in the world; they lived beside one of its biggest rivers; they were in the midst of the most beautiful forest, and apparently they had pouring down on their heads about the greatest rainfall of which he had heard — eight hundred inches in the year. He had heard that at a place called Cherrapunji there was a rainfall of six hundred inches, but he had not heard before of a spot in the world on which there was a rainfall of eight hundred inches. Living amidst Nature on that tremendous scale it was natural the people should consider that Nature was inhabited by spirits, and that they should look more to Nature for the spirits than to man. The author had said that in the main the people considered those spirits malevolent, but he also mentioned that they had a vague belief in a benevolent deity. He thought that question was worthy of careful attention on future occasions, because it would probably be found that the people did, as a matter of fact, have unconsciously at the back of their minds the belief that the benevolent spirit did in the main prevail. They seemed to have some idea of that because they sought to propitiate it, and they had some faith that their propitiations might have effect. Another point of great interest the author had mentioned was the remarkable intelligence which the people showed in certain directions. A most interesting picture had been shown of a cane bridge, which struck him with amazement, because on the Kashmir frontier he had seen bridges made of birch twigs, but he did not remember seeing one on such a big scale as that which the author had exhibited. The people, though they could not read or write and had no written language, might probably have great intelligence in other ways, and his experience among people of that kind was that they

had very retentive memories. He had also found they were very astute in the management of their own particular social and political affairs. In matters which concerned them they showed just as much intelligence as it was customary to find in more civilised peoples. The third point which particularly struck him was the author's reference to the democratic spirit amongst the people. According to the author, the chief expressed the general opinion of the people, and if he did not do so somebody else was very soon put in his place. Years ago, when he was in Chitral, at the other extreme end of the frontier from the Abor country, the chief was hereditary and was very autocratic, but he noticed it was only within certain very definite limits that he could exercise his autocracy. There were certain things he could do, but there were certain other things he could not do on any account. Apparently the slaying of the nobility was amongst the things that he could do. The chief came to him one day and said he was sorry to tell him that a certain noble had died on the previous day. Several other nobles had died quite recently, and he (the speaker) therefore remarked to him that he had noticed a rise in the rate of mortality amongst the aristocracy of the country, and it was quite likely, when he drew the attention of the Government of India to it, they would ask him to make an inquiry into the cause of the increase in the death-rate. The chief took the hint, and the nobility did not die quite so frequently afterwards. Apparently his own people raised no objection to it. One day the chief came to him and said that on the previous day, no doubt in a burst of enthusiasm and generosity, he had taken out the three hundred ladies of his household for a picnic. He said he enjoyed himself very much indeed, and so did the ladies, but he further stated that he could never do it again because it created such a ferment among his people. It would therefore be seen there were very strict limits within which autocratic rulers must keep. They could kill nobles, but not take ladies for a picnic. There were many other points to which he would like to have referred, particularly the magnificent vegetation, including the orchids, and the very beautiful insect life, but time did not permit him to do so.

Colonel Sir Thomas H. Holdich, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc. (Vice-President and Chairman of the Council), said he was glad to have the opportunity of saying a few words in appreciation of the paper. It was a very great advantage to those who were condemned to stay at home doing nothing, when any gentleman, who had the opportunity of travelling in such regions as those which had been traversed by the author, had also the faculty of keen observation and of graphic description such as that possessed by Sir George Dunbar. Added to the extraordinary compactness of the paper, he admired infinitely the clearness of the pictures which had been shown on the screen. So packed with information was the paper that he thought it might very well be expanded into a book, and he sincerely trusted that in the near future the author would carry out such a work. As an old surveyor he had followed with great interest the course of explorations on the part of the Indian frontier with which the paper dealt. They owed an immense deal of their knowledge of that country to that gallant corps, the Frontier Police, to which the author belonged. The latest surveys, so far as he remembered, were completed not very long ago by Captain Morshead of the Engineers, and many of those present would remember the extraordinarily adventurous journey of Captain Bailey which finally disposed of any question as to the course of the Brahmaputra, and, incidentally, whitewashed Kinthup, the well-known explorer of the Indian Survey Department, who for a very long time had rested under a cloud of suspicion as being a somewhat romantic liar. He was glad to say that Kinthup had now come into his own. He quite agreed with the author that the people of the country probably came from the north over the mountains. At the same time it must be remembered that there was a people, who must have been very much akin to them in appearance at any rate, who once occupied the plains of the Punjab, and in days which were prehistoric were gradually driven out of the plains of India into the hills by the advancing Aryans. How far those people occupied Northern India they had no means of telling, but he believed that in the country to the north-east of Lhasa, where the beginnings of the great Rivers Salween, the Yangtse, and others, were gathered together—that sort of no man's land between Eastern Tibet and Western China—explorers and scientific inquirers would find the most interesting records and evidences of an ancient form of civilisation such as were to be found nowhere else. The people there were not savages in the same sense, for instance, that the native inhabitants of New Guinea were. There were clear evidences about them of a former state of civilisation, particularly amongst those people who, claiming independence from China, were called the Lolos and lived by themselves in sections scattered about the country. This indicated to him that it was from Central Asia that civilisation first made its start, just, indeed, as humanity first started from there. There was one point about the paper which struck him as indicating a curious feature in Nature to which he thought attention had not been sufficiently given by naturalists, and that was the curious colour-scheme which seemed to exist in Nature in regard to flowers and plants in ascending from the plains up to high altitudes. In the lower altitudes, particularly in those parts of the Himalayas where he had himself been, he had always found exceedingly bright and vivid colours. For instance, the scarlet and

deep pink rhododendrons of Simla were well known to everybody. But as one ascended higher those colours gave way to lighter shades of red, finally merging into purple, then lilac, then white, until yellow was found at the top of all. That had always struck him as curious, because he had found it not only in the Himalayas, but in the Andes, on the Hindu Kush, and on the Alps, and probably the Chairman would confirm that it was the same in other parts of the Himalayas where he (the speaker) had not penetrated. He would like to know whether there was any direct connection between altitude and colour. Another interesting point to which reference had been made was the primitive social conditions which existed where the village community was, as the author had stated, the political unit. It had been stated that the chief sometimes established himself by the strength of his own personality and of his own right arm, and if he did not succeed in pleasing the people somebody else was put in his place. He would like to know the method adopted amongst the people for replacing him by some man more popular. Did they resort to a system of voting? Was election the earliest method of selecting a chief that the world knew? And if that was so it would be a matter of exceeding interest to him to know whether primitive woman also had a vote.

Sir Charles J. Lyall, K.C.S.I., C.I.E., said that as he was totally unacquainted with the region of the Abor hills he was not able to contribute much to the discussion. He desired, however, very strongly to support the suggestion Sir Thomas Holdich had made that the paper should find its place among a series which was too little known to the outer world, but which had considerable scientific merit, the Assam Ethnological Series of Monographs. Some ten books, he thought, had already been published, each of which discussed one of the numerous races found in Assam. The author's work was of a very high order of scientific accuracy, and the paper contained an enormous mass of information; and from what had been heard that afternoon he thought the author's observations were quite capable of being put into a shape in which they would greatly interest all ethnologists. The only Abors he had seen were those who had visited Sadiya. In those days, more than twenty years ago, we had, on the whole, friendly relations with them, and our diplomatic intercourse with them chiefly took the shape of bottles of rum. They were not very frequent visitors. He had always understood that the country the author had described was one of the very wettest on the face of the globe. The adventurous journey that was taken some twenty-five years ago by Colonel Woodthorpe and Mr. Needham across from the head of the Assam Valley to the Hukong Valley proved that, while in the rest of India the weather was generally dry, in that country rain continued perpetually, and that the rainfall for that season of the year must have been very like the rainfall during the monsoon in the rest of India.

Lieut.-Colonel F. S. Terry said he understood that in 1861 the rainfall in Cherrapunji was 905 inches, the amount for one month alone (July) being 366 inches. On one occasion in that year 41 inches of rain, it was said, fell in 24 hours. He had read somewhere that the rainfall in Cherrapunji last year was 900 inches.

Sir Steuart Colvin Bayley, G.C.S.I., C.I.E., in moving a hearty vote of thanks to the author for his most valuable paper, and expressing the thanks of the audience to Sir Francis Younghusband for so kindly taking the chair, said he had been greatly interested in the paper, because during the time he was in Assam he took immense interest in the explorations that were then carried out, such as those by Woodthorpe, Macgregor, and by Needham from Sadiya. The title of the paper was "Tribes of the Brahmaputra," but it was confined to the Abors and their congeners, and he wished some little comparison could have been made with the other tribes that were contiguous to the great river. He had been very much struck with the remark Sir Thomas Holdich had made in reference to the paper being capable of extension into a book, because he had wished for a long time that somebody would take up such a work. Forty years ago Sir Alec Mackenzie published a book giving a history of the various explorations into the country around the Brahmaputra, dealing principally with the Nagas; and Sir Charles Lyall had referred to the little monographs on individual tribes that had been published by the Assam Government from time to time which were of immense interest. If somebody would co-ordinate those into a big book, giving a history of the explorations from Pemberton downwards, it would be of extreme value. After hearing the paper he could not help comparing many of the customs of the Abors with those of the Angami Nagas. There were several points that required explanation. For instance, the wonderful skill they both showed in irrigation was striking. Then, too, what were the domesticated mithans kept for? Their milk was not drunk by the tribes, and they were kept for the purpose of ceremonial slaughter, and had also their use as a unit of pecuniary exchange. How such a custom had grown up deserved consideration. The method of cultivation known as "jhuming," which was so extraordinarily destructive, and which existed all round the frontier, in the Chittagong hill tracts, all round the Lushai country right up to the Brahmaputra,

ought to be investigated, and there were many other points of interest on which information was desirable.

SIR STEYNING W. EDGERLEY, K.C.V.O., C.I.E. (Member of Council and Chairman of the Indian Committee), seconded the motion, which was carried unanimously.

SIR GEORGE DUNBAR, who was recovering from a somewhat serious illness, was only permitted by his medical attendant to read the paper on condition that he left the room immediately he had finished. A proof of the discussion was forwarded to him, and in reply he writes:—It was a source of great regret to me that I was precluded from hearing the discussion on the paper. But I am glad to be able to avail myself of the opportunity given me to add one or two remarks on certain points brought forward by the speakers. As regards, in the first place, a belief in the existence of a benevolent deity, referred to by Sir Francis Younghusband, a number of the myths (I have collected about twenty-five in all) represent the gods as beneficent beings. Sometimes it is the Archer God, whose weapons we see in the sky (as Orion's belt); at others it is the Sun, who gave Eve to the Abor Adam. It may be of interest to add that the Abor for "human being" is *āmi*, which is not at all unlike the Arabic or Hindustani. In Lorraine's dictionary, which is based on the Padam Abor dialect, *Jimi-Jimiang* is given as "God, the All-loving," a dual and bi-sexual personality. The Padam Abors have, for a hundred years, possessed flourishing colonies along the foot hills, and within easy distance of Sadiya (the head-quarters of the frontier political district). It was to Membu that the courageous missionary, W. Krick, went in the eighteen-fifties. The American Baptist, and medical, missionaries, such as Lorraine and Jackman, have worked indefatigably among them. It is, therefore, within the bounds of possibility that the "All-loving" deity is an echo of Christian teaching; just as it struck me that the shrines of Pemakoichen bore a distinct impress of the older Nestorian missions north of the Himalayas. Still, amongst the Abors there is a general belief that the spirits of the dead medicine-men go direct to more benevolent spirits than do the souls of more ordinary mortals. And even, as regards the future state of the "laity," there exists a belief in the passing of the soul from the power of the demon who deprived it of life into the presence of a more benevolent Great Spirit. Sir Francis also referred to the intelligence of the hillmen. Now, although that sometimes doubtful advantage, the art of reading and writing, is unknown to them, they are remarkably quick at recognising themselves and their friends in photographs; understand, and occasionally scratch on the ground, rough plans to show the lie of the country, and are able to give an admirable idea of the gradients of a path—some tribes by bending up a stick, others by tearing a "section" out of a leaf. Nor is their memory contemptible. Their appreciation of the higher numbers, one hundred or over, is distinctly weak. They are strongest when the figures involved can be dealt with on the fingers and toes. Sir Thomas Holdich referred to Kinthup. I was within the borders of Pemakoichen (where he wandered, and was a slave so long) not much more than six weeks. But every step one took convinced one that Kinthup combined the indomitable pertinacity of an explorer, of which the survey of India itself, with all its records, might be proud, with, at times, the accuracy of a Baedeker. That his memory should have failed him on occasions is not to be wondered at under the circumstances. It was a source of great pleasure to those of us who went into Pemakoichen that Kinthup should have been vindicated within his own lifetime. Sir Thomas alludes to the election of the chiefs. In so democratic an assembly as the village council, if the nominal leaders wish to take a definite line in policy, such as peace or war, they are powerless in the face of definite opposition They can but persuade, which they endeavour to do in lengthy harangues. It is the "sense" of the village majority that rules. Voting would seem to take the form prevailing in the Saxon Moot—the loud shouting down of dissentients. Still, a figure-head of some kind is useful to organise "jhuming," divide the fields amongst the households, and entertain visitors. For the first he needs a clear head, for the last wealth of a patriarchal kind. So a would-be headman "nurses" his constituency by asking it to dinner. This impresses everyone with an idea of his wealth and hospitality. But, of course, as everywhere else, a commanding personality climbs irresistibly to the top of the tree. Headmen are elected by acclamation of the grown male population. There is no female suffrage, but women exercise a marked influence throughout the hills. In one Subansiri (Dafla) village I know a woman is deputed to take the annual subsidy they receive from the local government. Sir Steuart Bayley alluded in his remarks to the neighbouring tribes. I was fortunate enough to have the opportunity of either exploring, or visiting on duty, all the tribes from the Aka country to the Mishmi highlands, as well as one group of Nagas. The fullest possible notes were taken, and in some cases I lived in their houses. But ignorance of the language, indifferent interpreters, and rather short visits, do not offer firm ground for the publication of such observations as I made. But there are many obvious points of similarity in the appearance, beliefs, customs, and language of all these hill tribes. The difference between the Daflas, Hill Miris, and Galongs is very slight indeed. The Abors are distinct from the Galongs, and very different in language and customs to the Mishmis. A knowledge of Dafla would see one through the Hill Miri and Galong country, but no knowledge of Abor

would help one in the Mishmi country. Millet is the staple food amongst the wild and poor Mishmis; rice is cultivated throughout the Abor and Galong hills. Such points as I have been able to establish satisfactorily in a comparison between the neighbouring tribes have been dealt with in a Memoir of the Asiatic Society of Bengal, now in the press. There are, of course, as I should have had much pleasure in telling Sir Charles Lyall, a number of notes that are not embodied in that paper. They were collected because I had hopes, some day, of co-ordinating the whole history of the frontier in official, or semi-official, form. But I confidently expect just at present that other duties are to hand. Allusion was made by Sir Steuart to the mithan. They are the wealth of the householder and the sept to which he belongs. They are killed and eaten in sacrificial rites, and also when ratifying a treaty of peace, when they are cut up and cooked in the Tibetan bowls called *dankis*, that, with mithan, form the currency of the country. Conditions vary enormously, but a *danki*, which is a bowl of brittle white metal, ornamented with the conventional religious signs of Tibet (such as the "om," fish, wheel of life, umbrella, banner of victory, etc.), is worth from 12 to 35 rupees, according to its size, workmanship, and the ideas of the seller. Mithan are worth anything up to 90 rupees.

ELEVENTH ORDINARY MEETING.

Wednesday, February 24th, 1915; The Right Hon. Sir George Houston Reid, G.C.M.G., D.C.L., K.C., High Commissioner for the Commonwealth of Australia, in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Kerr, Harry Roe, care of Messrs. Steel Bros. & Co., Ltd., P.O. Box 132, Rangoon, Burma.

Nuttall, Walter Harold, F.I.C., F.C.S., The Cooper Laboratory of Economic Research, Watford, Herts.

The following candidates were balloted for and duly elected Fellows of the Society:—

Dubash, Peshoton S. G., 135, Highbury New Park, N.; and care of Postonji Bhicaji, Kimari, Karachi, India.

Lewton-Brain, L., Director of Agriculture, Kwala Lumpur, Selangor, Federated Malay States.

Mason, Charles Thomas, Sumter Electrical Company, Sumter, South Carolina, U.S.A.

Murfee, Professor Edward Hunter, A.M., LL.D., Brenau College, Gainesville, Georgia, U.S.A.

Vaishya, Ramjidas, Sweet Cottage, Gwalior, Central India.

Van Deventer, Harry R., Sumter Electrical Company, Sumter, South Carolina, U.S.A.

The paper read was—

THE ECONOMIC POSITION OF GERMANY.

By W. J. Ashley, M.A., M.Com., Ph.D.,
Professor of Commerce in the University of Birmingham.

The economic situation of Germany towards the close of last century was that of a country which had passed from being preponderatingly agricultural and had recently become at least as largely industrial, and which had left a position of internal self-sufficiency to take a place, for good and for ill, in the mutually dependent circle of international trade. It will need the recital of but a few facts to make this clear.

We may regard 1850, the middle of the century, as marking the turning-point. Up to that time the introduction of modern manufactures and machine processes had been slow; from that time onward it began to be rapid. Upon the area of the present German Empire lived, in 1850, a population of some thirty-five millions; by 1865 it had risen to forty, and in the last quinquennium the growth had been at the rate of almost 1 per cent. per year. After 1871 the movement was resumed with greater velocity; in 1900 the number of the population reached fifty-six millions, and the growth during the preceding five years had been at the remarkable rate of 1½ per cent. per year. This was the same as the highest rate ever reached by Great Britain, which was in the decade 1811–21, when the "industrial revolution" was in full swing. German writers are apt to fall into the same mistake as Malthus: to regard the growth of population as something self-moved, the independent and originating cause of all the other concomitant phenomena—the establishment of manufactures, the exchange of manufactured exports for imported food and raw materials. But it is evident that the increase of population was quite as much a result as a cause of the contemporary changes in production and transport. Of the population in 1850, three-quarters still lived upon the land; about the same proportion as in England a hundred and fifty years before. In 1871 the proportion had sunk to two-thirds; in 1900 it was certainly less than half, and of these quite a considerable proportion were largely industrialised in their circumstances and outlook. As late as 1871 there were only ten cities with more than 100,000 inhabitants; in 1895 there were twenty-eight. Going back again to 1850, Berlin then contained

less than half a million people; in 1900 it contained four times as many. It is difficult to calculate the amount of the foreign trade, in the middle of the century, of the territory that is now Germany, on account of the difference in the political organisation. It may perhaps roughly be estimated, adding together exports and imports, at somewhere about 1,000 million (one milliard) marks, or thirty marks (£1 10s.) per head of population; in 1900 it was ten times as great, or 192 marks (£9 12s.) per head. In 1850 the exports, such as they were, were half of them textiles; the larger half of these were still the older manufactures of wool and linen, which obtained all their necessary material from their own country. In 1900 the textile exports had, of course, grown enormously; but by their side, and of equal importance, were now the products of iron and steel. And finally, while long after 1850 Germany continued its old practice of exporting wheat to England, and, indeed, exported more corn and cattle to the countries outside than it imported from them down to the early seventies, in 1900 it was reckoned that between a sixth and a seventh of the nation's food came from abroad.

This will be enough to make clear the conditions on the economic side when the German Government brought forward its proposals for the creation of a big navy. It received the energetic support, by speech and pen, of many university professors, and among them of almost every economist of repute in the country. That this was so was a patent and conspicuous fact. The political opposition resented their appearance in the party arena, and dubbed them "Professors of the Fleet" (*Flottenprofessoren*). But their arguments quite certainly carried great weight with the educated classes, and especially in administrative and official circles; and they themselves were afterwards proud of the part they had taken. One of the most eloquent and widely-read among them, Professor Lamprecht—the first German historian to obtain a popularity such as Macaulay or Green or Michelet had enjoyed in other lands—after eulogising the Emperor in his History for the energy with which he set about converting the nation, adds, with emphasis, "his banner was followed, with complete understanding, before all others and from the very start, by the academic teachers of the nation."

I start by calling attention to the considerable part played by the professors, not at all by way of criticism, but simply to secure attention for their arguments; and to these we must now turn. They are most readily accessible in two volumes of Speeches and Essays, published in 1900 under the title "Handels- und Machtpolitik" ("The Politics of Trade and Power"), under the editorship, as the titlepage tells us, of Gustav Schmoller, Max Sering, and Adolph Wagner, "Professors of the Political Sciences at the University of Berlin." The conjunction of these names is significant, and especially the alliance of Professors Schmoller and Wagner, the leaders of two very different and not always very friendly schools of economists. Professor Schmoller has been for many years the most conspicuous figure among writers of the historical school, a man whose whole doctrine is evolutionary and therefore cautious, and, as some critics sometimes say, in relation to the Government inclined to temporise—a man of great influence in governmental circles. Professor Wagner, on the other hand, for an equal number of years, has pursued a course of more theoretical and abstract teaching, a course more akin to that of the still dominant English economic tradition; he is of a fiery and impulsive nature, the author of a doctrine of taxation which is sometimes found fault with as going in a Socialist direction.

Most of the arguments of the two volumes centre in the proposition, in which Schmoller and Wagner were agreed, that until Germany could protect by its own fleet its oversea trade —then, as now, some 70 per cent. of the whole —its economic position was insecure and at the mercy of any Power which could control the seas. I will quote a few passages; and in view of the language now used in Germany about the effect of sea power upon German food, I would call special attention to the references which these authoritative writers made to this particular part of the subject. They will show that the danger which Germany has incurred was contemplated as only too probable; and that they did not expect that any such doctrine as that food carried by neutrals is only conditional contraband would be of any assistance.

Listen first to Professor Schmoller:—

"However optimistically we may think of our agricultural progress, we shall remain a people which needs to import foreign foodstuffs; and therefore our existence is threatened if we are not powerful at sea."

And again:—

"The denser our population becomes, the more we must increase our exports, if only to pay for

our imports of food, materials and colonial produce."

Next turn to Professor Wagner:—

"Until we have a powerful fleet we are not sufficiently secured against the very real dangers of a hostile blockade, with all its grievous consequences for our import and export trade, for the feeding of our people and the employment of our workmen; and the position already reached and to be further gained in the future by Germany as a member of the world's economy remains entirely precarious."

When, a couple of years later, Professor Wagner threw himself on the side of the Agrarians in their movement for higher duties on corn, he carefully explained that this did not involve any change of opinion as to the purposes of a navy:—

"The naval policy is necessary for the safety of our people's food and of our workmen's employment. It is true that a strong German fleet is desirable for the sake of political power. But for our economic interests also, indeed for the security of our share in the world's trade—a share which is necessary to us and will become more necessary in the future—it cannot be dispensed with."

And on the subject of the food supply he wrote:—

"Supposing the lands which export agricultural produce are always willing and able to satisfy our demands, it must be borne in mind that, for a country in the geographical and political position of Germany, it is easier to have its supplies cut off than it would be for others. In particular, Great Britain is in a more favourable position, on account of its insular position and the supremacy which, at any rate for the time, it enjoys at sea, than our country wedged in between France and Russia."

Of the contributions by less generally known writers, two were especially devoted to the elaboration of the same thesis. One was by Dr. Ernst Francke, the able organiser of the moderate social reform movement and editor of the useful weekly journal *Soziale Praxis*. The following passage will suffice:—

"With the exception of the building trade, there is no great German industry which is not dependent to a considerable extent upon the exportation of its products across the seas . . . It is certainly not an exaggeration when we conclude that altogether some 24 to 26 millions of people in Germany" [out of a population then of 56 millions] "are dependent for their livelihood and employment upon the unimpeded inward and outward movement of commodities upon the sea routes. The keeping open of the sea and the continuance of German competition in the markets of the world is, therefore, a question of life and death for the nation, and one which concerns the labouring masses in the very highest degree."

The more detailed working-up of the argument was entrusted to a younger economist, Dr. Paul Voigt, a man of great ability too early lost to his country. Dr. Voigt produced a careful statistical survey of the whole field, which was printed first in the leading German monthly, the *Preussische Jahrbücher*, then in a separate edition soon exhausted, and then in the publication now under consideration. At the end of his survey he exclaims:—

"Almost four milliards of absolutely indispensable imports—materials, half-finished goods, and food—which, in the main, reach us by sea! What terrible misery even the temporary interruption of this importation would mean for Germany!"

And he concludes:—

"Considering how vastly the economic life of the nation is dependent on foreign trade, there can hardly be any doubt that a blockade which lasted any considerable time would bring Germany into subjection. An enemy who realises that will not allow our trade to pass by way of Antwerp or Rotterdam. He will certainly not let himself be restrained by the neutrality of weak States like Belgium and Holland, or by the thread-like fetters of international law, from attacking Germany on its most vulnerable side."

Such was the contention with which in 1898-1900 the economists of Germany came to the support of the Government's naval programme. Germany to-day, in spite of its fleet, is precisely in the position they pictured before the fleet existed. My purpose is to ask how far their account of the situation is still true? how far Germany is now vulnerable? Midway between that time and this, in 1907, one of the younger German economists, Professor von Halle, who is reputed to have been very active in organising the professorial campaign, sought to detract from the significance of its economic postulate by remarking, in a paper before the British Association, that "when a campaign was started in Germany to turn the attention of the people toward their oversea interests, they were shown to them, of course, through a magnifying glass." I cannot, myself, believe that men like Schmoller Wagner and Francke were not in earnest in every word they said; but in every political campaign there is certainly a danger of unconscious exaggeration. Moreover, it is possible that, apart from the navy, Germany is more secure to-day than it was in 1900 in consequence of being more self-contained. The argument as to the food supply might be and was used for other purposes than the support of the

naval programme; it was used by the Agrarian party in their movement for higher duties on foreign corn, as well as by those who, without being Agrarians, wished to bring about an improvement in agricultural methods.

Let us begin, then, by considering the question of food, on the assumption that outside supplies are cut off. This was the assumption, as we have seen, on which rested the argument of "the Professors of the Fleet"; and in current discussion in Germany it seems to be taken for granted that, so far, no supplies worth mentioning have actually come through. At the moment of writing (February 18th) it seems hardly likely that food will remain only conditional contraband. Even without the recent action of the German Government in taking control of all native supplies and restricting the consumption of the civilian population, it would seem to be obvious that, under present-day conditions, there is no longer any foundation in reason for the old distinction between the food of civilians and the food of the army. When the total supply is short, the more foreign food there is available for the civil population, the more native food, of course, there is set free for the armed forces. It would be absurd to suppose that the maintenance by England of the old distinction is going to be of any advantage to this country in a future war in which the enemy commands the sea: Germany in such a position of advantage would assuredly do what it has all along expected England to do now. Even if, however, no change takes place in English policy in this respect, and the difficulties Germany has to meet are only those of the scarcity of neutral shipping, the dangers and delays of transport and the expenses of payment with the exchanges against it, so far as they continue to be operative, the assumption will still hold good, that Germany will have to depend on itself.

Rye is still the chief bread grain of the people; but almost half as much wheat is also consumed; and it is customary with German writers to group the two grains together as "bread corn." And it is possible that in respect of bread corn Germany is a little more self-sufficing than it was fifteen years ago. The exact proportions will work out rather differently according to the years chosen. My own calculation, from the official figures of crop and import, is that in 1899–1900 the foreign imports were over 12 per cent. of the consumption, in 1912–13 under 11 per cent. Other estimates are even more cheerful for Germany. Professor Sering, of Berlin, perhaps the highest authority in the country on agricultural economics, thus expressed himself at a meeting of the German Council of Agriculture, in February, 1913, also, as I gather, basing himself upon official figures:—

"The magnitude of what our peasantry has recently achieved is not to be denied. With the help of co-operative societies, associations, schools and travelling lecturers, it has succeeded in lowering the proportion of bread corn which we have to draw from abroad from 16·6 per cent. in the first five years of the century to 10 per cent. in the years 1909–11. This is the work of our peasantry, for the peasantry holds in its hands more than three-quarters of the whole cultivated area of the Empire, and, roughly, the same proportion of the soil under corn crops."

And this would seem, on the face of it, to be the more encouraging for Germany, because the greater output has been obtained with the old staple, rye. According to the official returns, the annual crop of wheat rose, as I reckon, from an average of 3·8 million tons in 1899–1900 to an average of 4·5 in 1912–13, *i.e.*, some 18 per cent., while that of rye rose from 8·6 to 11·9, some 38 per cent. Germany still, before the war, imported about one-third of its wheat from America, Russia, the Argentine, and Canada; but the improvement in the yield of rye has been enough to turn it from a rye importing to a rye exporting country. In good years it now sends rye to Russia, instead of drawing it thence. In recent years it has exported, on balance, no less than half a million tons of rye annually, while in the nineties it imported, on balance, from three-quarters to a million tons.

Yet, after all, a deficiency in the total bread-corn supply of even 10 per cent.—to take the most hopeful estimate—means a shortage of more than five weeks' consumption; and I am not aware that any German economist of high standing has spoken lightly of the risk. But, outside scientific circles, there was certainly a tendency, for some time before the war, to take a very optimistic view of the situation. It was urged that, in case of need, the grain could be more completely ground, and less lost in the form of bran; and it was pointed out that, in the last resort, the quite considerable quantities of rye and wheat used for industrial purposes—for the manufacture of starch and corn brandy—could be appropriated for the miller and baker.

And in 1908 appeared an article by W. Behrendt, which attracted wide attention and had apparently a great effect on men's minds.

It was entitled "Potatoes in War," and it professed to show that any deficiencies there might still remain in the matter of bread corn could be made up from potatoes; that potatoes, as one of his admirers put it, provided "the national food reserve." For, to begin with, in the matter of potatoes Germany had more than was sufficient for itself. Next, it was reckoned that of the potato crop only 32 per cent. was used for human food, and 15 per cent. for seed, while 34 per cent. was used as fodder, 9 per cent. for the manufacture of spirits and starch, and 10 per cent. was spoilt. Surely something could be taken, if not from the cattle, from the distilleries; and, besides, the new process of potato drying and potato flake manufacture was going to save the 10 per cent. now spoilt. All that would really be necessary, then, if foreign supplies were cut off, would be a little readjustment of consumption. Accordingly the Emperor had a certain body of apparently expert opinion behind him when he declared, in February, 1913, doubtless in all confidence:—

"There is no longer any doubt that Germany not only can now, but also will be able for the future, to supply bread and meat for all her people."

A sign of the satisfaction felt in certain quarters was the article from the pen of Count Otto Moltke, a Conservative member of the Prussian Landtag and the Imperial Reichstag, which appeared in the *Preussische Jahrbücher* only five months before the war. This declared, on the authority of official figures, that the English consumption of corn was actually less than the German, so that the German harvest by itself was capable of giving the average German more than the Englishman got; while, on the same authority, it appeared that the German meat consumption had grown with extraordinary rapidity of late, and that the figures were now on a level with those of England. Just a little pinching, just a little sacrifice of comfort, was all, he implied, that war could be expected to involve.

Even accepting the data relied upon in the foregoing arguments, there were weak places in the situation which were well known to cool observers. The cessation of the import of wheat meant the withdrawal of a third of the whole wheat supply. Now wheat flour is used not only for the white rolls eaten by the well-to-do; it is mixed with rye flour in the making of all the better varieties of "black" or "rye" bread in proportions of from a fifth to a third. The increasing fondness for wheat is shown in the official statistics, which indicate a decrease in the consumption per head of rye from 151 kilogrammes in 1894–98 to some 144 in 1909–13, and an increase of wheat from 86·8 kilogrammes to 89·1 in the same period. The figures of the two grains do not quite harmonise, but they indicate the tendency in the two opposite directions. A larger resort to rye would mean a reversal of these tendencies. "A good thing," said some writers; "it is rye bread from which Germanism ('Germanenthum') has for thousands of years drawn its incomparable strength and health." But food habits are notoriously difficult things to alter suddenly.

And then the agricultural labour problem gave reason for anxiety. With the growth of the industries of Rhineland and Westphalia, agricultural labourers have been more and more drawn away in recent years from the big corn-growing estates east of the Elbe: they were attracted both by higher wages and by the hope of reaching a position of greater social independence. Let us hear Professor Sering on the consequences:—

"In the place of the labourers who have left come more and more foreigners" [the "season workers" from Russia and Russian Poland]. "According to the Occupation Census of 1907 they constituted in Silesia and Saxony 15 per cent. and 20 per cent. respectively of the male labourers. The number rises year by year. In the whole of Germany in 1912, 729,000 'legitimation cards' were issued to season workers, of whom 397,000 were employed in agriculture. More and more does the employment of these foreigners become the basis of estate management . . . So we are at the mercy of foreign Governments whether our fields shall be ploughed and reaped; and if a war should break out, the harvests in extensive districts will be ruined."

As it happened, when the war broke out many of these "Wanderarbeiter" had already reached Germany for the season; and it would seem that as many as possible have been compulsorily retained over the winter and spring. Just what is going to happen next harvest time it would be unsafe to predict; but the labour position east of the Elbe might very well create a certain sense of insecurity.

But a far weightier reason for anxiety was a fact not generally known in Germany but understood by some, at least, among the statisticians, and that was the very doubtful value of the official statistics of production. During all these months of war this has been the skeleton in the

cupboard of the German people. In all lands harvest figures are the weakest department of Government statistics. They commonly depend on estimates, not on enumeration; so that some severe critics will not honour them with the name of "statistics" at all. That the German figures contain a considerable element of probable error has been pointed out in statistical publications for some years past. Thus Professor Ballod, of Berlin, a leading statistical writer and one specially conversant with agricultural matters, wrote in 1907:—

"The method of estimating the crop was altered in 1899, and reports by local officials replaced by reports from local experts. There can be no doubt that the new method approaches more nearly to the truth; and yet even to-day errors in individual reports of as much as from 10 per cent. to 20 per cent., and in the total estimate of from 5 per cent. to 10 per cent., must be regarded as very probable."

Five years later, a writer, Georg Frohlich, in Schmoller's *Jahrbuch*—the most solid economic periodical in Germany—expressed himself in the same sense, and gave some of his reasons. The voluntary crop reporters number, he tells us, some 7,000 persons, and their districts are from 50 to 100 square kilometres in extent.

"In the time-consuming business of drawing up estimates for such wide stretches of land there are possibilities of quite considerable mistakes. Competent critics regard an average excess of from 10 to 20 per cent., or even more, as possible. Since we have had the new system of reports the figures have gone up from 12 to 19 per cent. This may have been caused by the local experts, who send in the returns and are usually very capable farmers, ascribing to other farms results as good as those they obtain themselves.

"It is possible, therefore, that our imports of bread corn are not from 12 to 20 per cent. of our consumption, but, on a moderate estimate, from 15 to 25 per cent., perhaps more; *i.e.*, that we are dependent on foreign corn for from two to three months of the year."

So far the grounds for serious doubt about the official figures have not been stated. I gather from references to publications I have been unable to obtain that Professor Ballod has become more and more convinced on the point, and has set forth the reasons in a number of technical publications. And at last the easy optimism of Count Otto Moltke, in the March number of the *Preussische Jahrbücher* already referred to, drew forth from Dr. Ballod, in the July number of the same magazine, an article which must have been disconcerting reading for those who got hold of it. The following is a summary of the argument on this, the most vital, point:—

"No one can say whether the harvest estimates are not 10 per cent., 15 per cent., or even 20 per cent. too high . . . In the province of Posen they are certainly too high. The estimated harvest, *less* what we know from transportation statistics to have been conveyed out of the province, would leave 325 kilogrammes per head, a quite impossible figure; 'even the Polish stomach does not need as much bread as that.' Higher and more improbable figures still were returned from the three other eastern provinces of Prussia—East and West Prussia and Pomerania; they would mean a consumption per head of 371 kilogrammes. Assuming a consumption in the four eastern provinces of 250 kilogrammes, which is somewhat higher than the official average for the whole empire, the harvest even then must have been, in those provinces, 22 per cent. less than the estimate."

In his subsequent argument he assumes an excess in the estimate for the whole empire of 15 per cent.

This narrative will have helped us to realise the probable state of mind of the German Government during the last six months. In spite of the much-praised efficiency of its officials, it really has not known, *with certainty*, what amount of corn it could count upon within the country. The self-satisfaction natural to all Government offices, the tendency of Agrarians to magnify their agricultural services, the wish to reassure the public, the public committal of the Emperor a year before to the big harvest figures, all these influences would naturally lead the Government to speak confidently of an adequate supply. Meanwhile there have probably been those in high places who have known that, if their armies did not "hack their way through" in a very few months, the food outlook was far from bright.

As soon as the war had been in progress a couple of months, and the official class realised that things were not going quite as quickly as they had anticipated, the Government began to be urged to use its influence and, if need be, its authority, to bring about the necessary adaptation of consumption to needs, and various attempts were made to work out the details of the necessary transposition on the basis of the official figures. One such was in a pamphlet by Von Braun, head of the Agricultural Department of Bavaria, which came out in October. He reckoned that the needs in time of war would be actually less by 3 per cent. than in time of peace, and this chiefly because the army can feed itself, to a large extent, from the resources of occupied territory, "and with the further

victorious progress of our army this will be the case in increasing measure." To allow for the same per head consumption for this diminished number in 1914-15 as took place in 1912-13, there would need to be—considering that the harvest of 1914 was already calculated as likely to be 15 per cent. less than in the record year 1913—some three million tons more bread corn than would actually be available. This could be obtained by using for bread one million tons of the barley that would otherwise be used for fodder, together with six million tons of potatoes, equivalent in food values, he states, to two million tons of bread corn, and derived from the surplus supplies of 1913 and 1914. But, as there would be already a deficit of three million tons of barley, hitherto used chiefly for fodder, owing to the cessation of Russian imports of barley, there would thus be of barley a total deficiency of four million tons. This deficit could be made up by a quarter of a million tons of barley saved from malting, because of the falling off in the export of beer and in the male consumption (with the army absent); by using the surplus supply of oats (one and a half million tons); and by turning to fodder uses the six million tons of sugar beets (equivalent to one million tons of fodder barley) set free by the disappearance of the sugar export to England. This still left one and a half million tons of barley fodder wanting. But against this could be set the surplus hay harvest of 1914, which happened to be a particularly good year and was reckoned to be as much as 11 per cent. above the decennial average. This disposed of the difficulty of ordinary fodder ("Rauhfutter"). There remained the loss of two to two and a half million tons of other imported feeding-stuffs of various kinds, maize from oversea, oilcake from Russia, and so on. But if it came to the worst, the pigs could be killed off earlier, and the nation must content itself for a year or so not to increase its stock of cattle. The bed-quilt—to use a favourite image of these writers—would be a little skimpy; but the nation would have no serious difficulty in twisting its limbs so as to keep under cover.

Some such calculations must have underlain the subsequent Government measures; and two questions suggest themselves: will the shifting around of foods and the substitution of one for another be dietetically adequate, and can it be brought about? On the first point Professor Ballod thus expressed himself last July:—

"The potato is a one-sided food. It contains carbohydrates (starchy substances), albuminoids (or protein) and fat in the proportion 170:2:1; while the need of the human body is 10:2:1. Great as are the advantages of the much-praised drying process, to prevent the loss of quantities of potatoes otherwise spoilt, it will not solve the problem; for the supplementary quantities of protein and fat have still to be supplied to fit it for human or animal use. It has been said that in time of war it would be possible to prohibit the use of corn in distilleries. But most of the corn so used is of a quality which would anyway only be used for fodder. And half the food values remains in the residues ('Schlempe') which leave the distilleries and are used for feeding cattle—indeed, almost all the most important part, the protein and fat. As these are the substances of most value—the carbohydrates can easily be supplied from sugar beets—it is doubtful whether any real saving can be effected in that manner. Far greater quantities of corn are used in the brewing of beer. But, again, we have to notice that from two-thirds to three-fourths of the protein and fat remain in the malt which is used for the feeding of cattle."

And Professor Ballod's conclusion was that, on the whole, Germany was worse off in respect of food, rather than better, than fifteen years before.

"Fifteen years ago we could hope that, if imports were cut off, we could still manage with our home supply, if energetic measures were taken, such as the prohibition of distilling and brewing; to-day that is no longer possible. True, our importation of bread corn has receded in recent years, and this explains the current optimism. But, on the other hand, we must emphasise the fact that the bread corn question cannot be considered by itself; it must be considered in conjunction with the supply of fodder and other feeding stuffs. The *total* import of foodstuffs has risen very markedly. It is a fearful self-deception to suppose Germany can live eleven months on its own bread corn. It can manage, yes; but only if it can continue to import 60 per cent. of its fodder."

The further question remains: granting that the proposed readjustment was pretty satisfactory from a dietetic point of view, as well as statistically possible, could it be brought about? It must be remembered that quite two-thirds (Sering, as we have heard, says as much as three-quarters) of the cultivated area of Germany is cultivated and mostly owned by peasants, most of them working what we should call small farms and very many quite tiny farms. To control the cattle feeding and the sales of all these small owners was a task from which even German officials might well shrink. And, within two or three months after the beginning of the war, it was found that instead of bread corn being carefully confined to human consumption, the very opposite was taking place.

In recent years half the barley, as we have seen, consumed in Germany has come from Russia, and it is this which has enabled the country to add so rapidly to its stock of pigs. When this was cut off by the war the price of barley rose even above that of rye, and the peasants naturally began to treat their pigs to rye and diminish by so much the supply available for bread.

The Government's first practical steps were to decree minimum prices of wheat and rye and bread, to give instructions as to the proportions of wheat, rye and potatoes to be mixed in flour, and to prohibit the use of bread corn for fodder. These measures seem to have met with little or no success. Dr. Helfferich, who is now in charge of German finances, boasted in a famous speech in October that the German people possessed this great advantage: "a spirit of self-sacrifice (*Opferwillen*), unattained by the French and unknown to the English." But this superiority has not displayed itself, so far, in everyday business life. And the Government was embarrassed because it could not make up its mind what line to pursue in the matter of prices: whether to make them pretty low in order to quiet the people for the time, or to make them pretty high in the hope that this would reduce consumption and prevent the national food resources from being too rapidly drawn upon. The Socialists told them with perfect truth—they can find it set forth at length in all the standard text-books of economics — that for the great mass of the people food is not a thing which will be economised to any considerable extent, save under compulsion; it is a case of what is known as "a relatively stable demand." The Government compromised, with a plan of permissible increases of corn prices at specified periods; and of course the farmers were disposed to keep back their supplies from the market till the higher prices were reached. English and German human nature is singularly alike in matters of this sort! Here in a Munich paper is a report from Mannheim, perhaps the most important corn market in the empire next to Berlin. It is dated January 14th of this year:—

"In consequence of the limitation imposed by the regulations about maximum prices, transactions, this week as last, could only be carried on on a small scale. In the produce exchange hardly any business took place, although there was no want of intending purchasers. In the retail trade a certain quantity of supply was forthcoming, although it was quite evident that farmers were holding back."

And the spirit of self-sacrifice has not hitherto been more marked among the bakers; for a fortnight later the Burgomaster of Cologne declared that in that city alone more than a hundred master bakers had rendered themselves liable to prosecution for breaches of the new regulations.

The next step accordingly was to create a great corn company, under Government auspices, with powers of compulsory purchase, which should buy up large quantities and hold them until May. But even this measure was soon realised to be inadequate. Early in January Professor Ballod published an article in *Soziale Praxis*. In this he stated, as the result of his calculations, that, in spite of all the Government's appeals to the farmers, some one and three-quarter million tons of corn had already been fed to cattle more than in the previous year. And he made the momentous declaration that, while in normal times the human consumption of corn in Germany amounted to a million tons a month, there was now available for the seven months until the next harvest only some seven-tenths (to be exact, ·714) of a million. His advice was that corn and flour stocks should be expropriated by the State. After taking a fortnight longer to think about it, the Government took his advice; and, as we all know, the people of Germany are now all being put on rations. Apparently the idea is (to judge from the restrictions imposed upon bakers) that the people must content themselves with three-quarters of their normal bread consumption, and presumably this three-quarters in weight is to contain a considerable proportion of potato flour.

And now, says the Imperial Chancellor:—

"It is a matter of organisation. The State has taken the matter in hand . . . The organisation which will have to be created will be a very difficult business, but these difficulties we expect to overcome. Our political system has shown that it can cope with the gravest tasks of organisation."

"Organisation" is a comforting word; and the German Government has in the past carried through great organising tasks. But for these it has usually taken its own time; and every student of administration knows that it has sometimes made bad mistakes. The treatment of the food problem in Germany before February 1st was certainly not particularly well-informed or strong or consistent. The appropriation of supplies by the Corn Company, the allotment to the several towns and districts, the control of the bakers and the public by

the muni ipalities, may all be managed with reasonable efficiency. But other foods, and especially meat, may have to be brought within the scope of the system; and the present plan all rests on the assumption that the people will continue to be able to *pay* for their bread. It would be most risky to prophesy; but in the best event for Germany, and assuming all imaginable docility, the nation, if foreign food supplies continue to be cut off, is going to be subjected to an irksome and discouraging *régime*.

I have left myself little time to speak of the industrial side. I shall therefore say nothing about the supplies which are most urgently needed by Germany for war purposes—copper, petroleum, and rubber. The situation as to these is pretty well understood; and I will only remark that when Germany begins to have recourse to the copper on its church spires—those undeveloped "copper mines" of which they speak so confidently the operation of stripping it off is not likely to have a very encouraging effect upon the people. What I shall say will concern a few of the staple industries. First, we must recognise that, in relation to coal, Germany stands in a very strong position. It possesses vast supplies, larger even than those of Great Britain, and it has been on this basis that its recent industrial progress has been mainly built. But the German Government, with all its skill in organisation, has not solved the problem of combining universal liability to military service with the maintenance of production. Owing to the withdrawal of its miners on military service the output of coal in what is by far the most important mining district, that of Dortmund, was 26 per cent. less in the third quarter of 1914 than for the corresponding period of the preceding year; and that for the concerns comprised in the Westphalian Coal Syndicate (which is coextensive to a large extent with the Dortmund district) was for the last quarter 29 per cent. less than the year before. Still all the workpeople the Government choose to leave at work can doubtless find employment. In the iron and steel industry the situation is almost, but not quite, as strong. Germany, in Luxemburg and Lorraine, has vast supplies of phosphoric iron ore (minette), which it has been enabled to utilise through the invention by an Englishman, Thomas, of the basic process—the second great cause of Germany's recent industrial development. The weak points are two. For the iron and steel manufactures of the Ruhr district, which produces somewhere about two-fifths of all the iron and steel of Germany, the industry has employed not only old and new iron scrap in enormous quantities together with minette from Lorraine, but also a good deal of imported ore. The proportion of imported ore to the total consumption seems to have risen lately, and in recent years to have been about one-quarter. Of this, rather less than one-third came from France, and probably even more is now available from occupied territory, but as it is minette it is not so suitable as Westphalian uses; rather more than a third came from Sweden, and some part of this is presumably available so long as Germany commands the western end of the Baltic, though the stoppage of the trade by the North Sea has already sent up its price very considerably; the other third came from Spain, and being hæmatite is now contraband and doubtless quite cut off. There must be therefore a certain limitation of raw material. This is the special weakness of the Ruhr district. That of the Lorraine-Luxemburg district is in the matter of labour. It has no old stock of iron-workers, and it is largely dependent on season workers, who come from Italy. These usually go home for the winter; and Germany is said to be negotiating now with Italy to get them back.

We should expect that the large demands which the German Government are making upon the manufacturers of munitions of war would have kept the iron and steel concerns very busy. Yet if we may rely on the usual trade returns, the total pig-iron production of the German Empire has been less than half, from August to December, of what it was in the previous year; while the deliveries of the steel syndicate in the fourth quarter of 1914 were not much more than half what they had been in the corresponding period.

Such iron-workers as have been allowed to remain are probably busily employed on Government orders; and the same process of adaptation of engineering and other works to the requirements of war time that has been so conspicuous in England has been equally successful for the time in Germany. But another side of the economic problem is presented when we reflect that machinery and iron and steel products head the list of German exports; in 1913 they furnished over one-fifth of the whole volume of export trade. Most of this trade must have been lost since the war began. Some

40 per cent. of Germany's total export trade used to be with the now hostile countries, and probably quite this proportion held good for the iron and machinery group; the removal from the seas of Germany's shipping, and the very limited tonnage available of neutral shipping, can have left very little of the remainder. This fact has a very direct bearing on the question, how Germany is going to pay for any imports it may manage to get hold of, and helps to explain why the Government is hoarding gold.

While the allied mining, iron, and engineering groups form the solidest part of the German industrial structure under present circumstances, the second of the export groups, the textile trades, forms the most vulnerable, and that both on the side of the supply of material and on the side of the disposal of product. They contribute about 12 per cent. of the total value of German exports, and give employment to some 1,370,000 persons. Of these the large majority are females; the figures, therefore, do not represent the same number of dependents as in the heavy male trades. On the other hand, the numbers dependent on employment cannot be reduced by military service; nor can the textile trades, except in the case of woollen goods, be much helped by Government orders.

The consumption of cotton wool has been rapidly growing. To go no further back than the time of the first naval programme, in 1896-1900 it averaged 302,000 tons; in 1911-1913 it averaged 475,000. This the country has in recent years obtained, to the extent of some 17 per cent. from Egypt and British India, and these sources of supply are now cut off; to the extent of 79 per cent. from the United States; and the rest from miscellaneous sources. It is well known that German spinners carry much larger stocks of cotton than their English competitors, and, to judge from the statistics of the International Federation, the stocks of cotton in German spinners' hands on March 1st, 1914--the so-called "invisible supply"—was enough for approximately twelve weeks' normal consumption. Supposing, like some other trades in Germany, the cotton-mills are now working half-time, that allows for twenty-four weeks. Spinners' stocks in August are commonly considerably lower than in March, and this fact may balance the probability that there were considerable quantities stored in the commodious warehouses of Bremen. Allowing for the probability that large quantities were seized at Antwerp, and making allowance for the great depression in the trade in August and September, when a quarter of all the textile operatives were totally out of work, it is difficult to see how the German cotton-mills can go on for more than, say, nine months from the outbreak of the war without fresh supplies. These considerations sufficiently explain the growing anxiety of late about American imports. Considering, moreover, how limited is the available neutral shipping, there can be little doubt that Germany will have to pay heavily for all the raw material it can get.

The German cotton manufacture, however, is a typical example of an export industry in that it is dependent on export for a very large part of its market — far more than are the iron and machinery trades. It is not so dependent on an outside market as Lancashire is, yet probably between a third and a half of the fabrics produced are sold to foreigners. Some of its branches, we are told, such as mixed fabrics and hosiery, are dependent on foreign markets for half their sales, some even for three-quarters. A glance at the complicated trade figures will show that somewhere about half, perhaps more, of all these exports has hitherto gone to what are now hostile countries. Even supposing — a large assumption — that Germany could manage to reach its neutral customers, the price it would have to pay for its material would put it at a hopeless disadvantage in all the countries that could be supplied from England, America, or Japan.

So far as the supply of material is concerned, the German woollen industry is in a worse case. With the improvement in German agricultural methods, the number of sheep kept in the country has been rapidly dwindling. In 1900 it was nearly ten millions, in 1912 it was under six millions; for comparison it may be added that in England and Wales alone in that year it was over eighteen millions. The woollen industry is, therefore, almost as dependent on imported material as the cotton trade. Three-fifths of the mill consumption were merino. Of this more than four-fifths have hitherto come from Australia and the Cape; and of the crossbred (the other two-fifths consumed) almost half usually comes from Australia also. Altogether, two-thirds of the raw material have been brought from what are now hostile countries. The Argentine and Uruguay, the only other large sources of supply, can doubtless increase largely their sales to

Germany; but it cannot be supposed that they can do anything like fill up the gap.

As to stocks in the country, the foremost trade authority in this country reported, at the end of 1918, that stocks both of raw wool and tops were then "abnormally low everywhere." The one cheerful bit of news for Germany has been the appropriation by the Government of quantities of wool found in Roubaix and other French woollen centres now occupied by its troops. But the amount can hardly be enough to keep the industry going for any length of time. It will have been noticed in the papers that the military authorities have taken over all the woollen blankets and the like to be found in the Berlin factories and shops; and that a wool week has recently been organised to give patriotic persons an opportunity to contribute all the old woollen articles they can spare for the manufacture for the benefit of the troops of what may be called without any disrespect by its trade name of "shoddy."

As to the silk industry, that can be pretty comfortable about its materials so long as Italy remains neutral. But hitherto half its product has been exported; and of these exports more than a quarter, *i.e.*, an eighth of the whole, before the war, came to England. Of particular classes of fabrics the proportion exported to England has usually been much larger. Thus, according to the last figures I have been able to get hold of, of the silk and velvet trade of Crefeld—those for 1907—15·5 per cent. of Crefeld output went to England and 6·6 per cent. to France—*i.e.*, in all between a fifth and a fourth.

Of the smaller textile industries, those of linen and hemp, and that of jute, I need only add that of the former four-fifths of the material have hitherto come from abroad and more than three-quarters from Russia; and of the latter practically all the material has been drawn, until the war, from British India.

From textiles one naturally turns to the leather trades. But I have only time to remark that about half the total supply of hides was drawn from abroad, and about a third of the import came from enemy countries, chiefly British India and Russia. There is already such a shortage of leather that the Federation of German Boot Manufacturers represented to the Government in the middle of January that, unless something were done to overcome the leather famine, many boot manufacturers would have to close down in a few weeks.

Of other industries I may just mention the chinaware and porcelain group, usually disposing of two-thirds of its output abroad, and recently sending a third of this export to what are now enemy countries; and the jewellers and workers in precious metal who normally export some three-quarters of their product.

These are all among the older trades of the country. But if one turns to the newer trades the result is the same: they are all cut off either from a large part of their market or from a large part or the whole of their material. Take three very different examples. The shipping business of Germany has of late years been growing by leaps and bounds; and a system for supplying, and incidentally for controlling, dock labour at Hamburg has been exhibited for our admiration. But now that the German merchantmen are mostly shut up in port, the labour exchange in the month of November, 1914, found engagements for only 2,300 dockers, as compared with 33,000 in the same month of 1913. Aniline dyes, again, have been one of the main boasts of modern Germany: in the years between 1900 and 1913 the value of the exports almost doubled (from 77 to 142 million marks), and of these a third used to go to Great Britain and other enemy countries. And, finally, take that humble but popular commodity, margarine. For its production Germany imported palm-nuts and copra in 1913 to the astounding value of 226 million marks, six times as much as in 1900. But of the palm nuts—about half the whole—nine-tenths came from British West Africa, and of the copra almost half from other British possessions.

Bearing in mind the conditions I have sketched, let us place side by side two remarkable utterances. One is from Prince von Bülow in his book "Imperial Germany," published a year or so before the war:—

"We have entrusted millions to the ocean, and with these millions the weal and woe of many of our countrymen. If we had not in good time provided protection for these national possessions we should have been exposed to the danger of having one day to look on defencelessly while we were deprived of them. But then we could not have returned to the comfortable economic and political existence of a purely inland State. We should have been placed in the position of being unable to employ and support a considerable number of our millions of inhabitants at home. The result would have been an economic crisis which might easily attain the proportions of a national catastrophe."

Compare with this the language of Dr. Rathenau, head of the great Allgemeine Elektricitäts-Gesellschaft, in December last:—

"German industry is faced with the task of converting its organisation, hitherto based upon a system of imports and exports, into an organisation appropriate to a country thrown upon its own resources."

And this, he implied, there was no doubt it would be able satisfactorily to accomplish.

Which of these prophets is most likely to be justified by the event? Is it possible for an industrial and exporting State to retrace its steps, without undergoing great hardship while it adapts itself to its narrower quarters? It is not only the food quilt that the nation has to twist its limbs to get under; it is the employment blanket also. Von Bülow, no doubt, was unconsciously magnifying the need for a navy, just as Rathenau has been minimising the difficulties of adaptation. But can it be seriously doubted that the balance of probability lies with the ex-Chancellor? We need not expect any dramatic breakdown of the whole economic structure; for some months the country may struggle along on its present supplies, and it will probably continue to get in some of its materials from abroad and pay for them by exports or by gold. Moreover, the vast Government orders will keep large bodies of the people employed, and enable them to purchase their requirements, even at enhanced prices. But I cannot but believe that, after a few months, if the Allies continue to command the seas, unemployment and short time will become more and more prevalent, and pauperism and distress grow to alarming proportions.

In spite of the activity of the war material trades, and the vast numbers called up for military service, the proportion of the members of trade unions totally unemployed—of short time there are no figures—was more than three times (7·2 per cent.) as great at the end of last December as the average for the preceding five years, and almost three times as great as in England. And while military orders were continuing to reduce the total percentage, it is significant that the number went up again in December among the building operatives, the textile workers, the leather workers (other than saddlers), the porcelain workers, the bakers, miscellaneous factory operatives, and even among municipal employees.

We are told of the wonderful organising and administrative ability of the German civil service. I am inclined to think that there is a tendency in some quarters in England—in reaction from extravagant anticipations of an early victory for the Allies—to go to an opposite extreme and overestimate the effectiveness of the German too official machine. The German *Beamtenthum* has done considerable things for its country—it is honest, hardworking, systematic. But I decline to take it quite at its face value. It makes a proud and justifiable display of all its achievements, but I doubt if it can show anything quite so big as the way in which this country took up the colossal task, not only of sickness insurance, but also of unemployed insurance—which German administrators had been afraid to tackle—and all in a single year. And the social situation in Germany is such as to add vastly to the task. It simply is inaccurate to say, as Dr. Helfferich did, in his historic speech, that "Germany has at its disposal an incomparably better economic organisation than its enemies," if he meant England. Our whole system of adjusting wages in the staple trades of the country by negotiation between masters and men, imperfect as it is, is the admiration and despair of social reformers in Germany. Here it works with friction, of course; but, as we have had the satisfaction of seeing of late in the coal industry, and in the railway service, it is working; and in Germany in the big industries there is nothing like it. No one who knows Germany at all intimately is ignorant of the fact that the relations between classes in this country — much as they leave to desire—are incomparably more friendly, more intimate, and more wholesome. With all our faults, we are essentially a far more united people. This cannot but tell in a struggle like the present. And when the German administrators have to take up in earnest the task of "return to a purely inland State," and of the redistribution of the working people among the occupations that survive, they will find it, I expect, one beyond their powers.

DISCUSSION.

MR. ALFRED MILNES said he had listened to the paper with that kind of admiration which those who knew the reputation of Professor Ashley had experienced, with every satisfaction, but with not the slightest surprise. It had occurred to him (the speaker) that there was just one small contribution which quite pure economics might make to a paper of such extreme concrete weight as the Professor's, and that was a little caution to follow-

citizens to remember that what was called economic pressure would always have to be reckoned, not only in terms of commodities and their sufficiency or insufficiency of supply, but still more importantly in terms of the psychological conditions which that deficiency might arouse in the people concerned. There were, as he (the speaker) had ventured to put it in rather a frivolous way, wide extremes with which men would meet what was called economic pressure. There was the class of man who would say, "Oh, look here, my half-a-crown pair of gloves has cost me two-and-nine. Really, we cannot stand this kind of thing and the war must stop." There was another set of people who would say, "The enemy has got my coat and waistcoat, and I will be hanged if they shall not have my shirt, but I am not going to give in." There was a whole difference between the effects that might be produced by a different quantity of pressure upon people of different psychological habit. It was the great Austrian school, led by Professor Bohm-Bawerk, that had brought forward more conspicuously perhaps than any other thinkers that psychological aspect of the matter. There seemed to be a danger on the part of fellow-citizens of perhaps slightly exaggerating the hopes that were built upon what was called economic pressure upon Germany. We had learnt to discount the German culture, and to think much less of their civilisation during the last few months, and some of our leading scientists had at last dared to say that there was to be found some scientific attainment outside of Germany after all; but we should not be in the danger of underrating what he believed to be one of the great Teutonic characteristics—their dogged endurance in a struggle. If that were so, it had to be remembered that that economic pressure, so brilliantly described in the paper, had to be estimated in two dimensions—firstly, in its quantity reckoned commoditatively, and, secondly, in its effect reckoned psychologically.

The Chairman (the Right Hon. Sir George Houston Reid, G.C.M.G., D.C.L., K.C.), in moving a vote of thanks to the author for his valuable paper, said the fact that no lively discussion had been excited by the paper was one of the strongest compliments that could be paid to the Professor. He (the speaker) had had a long experience in the art of picking holes in speeches and addresses, but he could not manage to find any serious objection to any of the statements contained in the paper—which was one scarcely to be dealt with in an impromptu fashion, it being so full of solid elements of thought. One of the most striking features of the address was its absolutely impartial and well-balanced statements; the author had discarded patriotic feeling and indignation in dealing with the subject because it was one in which such elements would tend to weaken and confuse the value of the paper. The war had upset almost all the moral attributes of everyone in judging of anyone who happened to be on the other side. It was almost a consolation to know that our German antagonists had acted so badly that we could honestly criticise their conduct, although it was not quite a natural characteristic of the British race to express hatred, even under circumstances of great provocation. He admired the balance of the British race under the tremendous struggle in which it was engaged. He did not know that we had fully realised what a tremendous strain it was going to be upon the Empire and upon our Allies before it was over. The Germans had an enormous number of good qualities; and now that they had thrown overboard the Ten Commandments, they had, for the moment, acquired additional strength, which, however, had in it the elements of future weakness. In one of the quotations contained in the paper would be seen the sort of view, before the war, which had been expressed in the actions of the German Government since the war. Dr. Voight had said, sixteen years ago: "there can hardly be any doubt that a blockade which lasted any considerable time would bring Germany into subjection. An enemy who realises that will not allow our trade to pass by way of Antwerp or Rotterdam. He will certainly not let himself be restrained by the neutrality of weak States like Belgium and Holland, or by the thread-like fetters of international law, from attacking Germany on its most vulnerable side." That was a remarkable expression, coming, as it did, from a distinguished German in a time of profound peace. Evidently at that time there was the idea that even International law was a fetter, and only a fetter with the strength of a thread. That was the worst thing about Germany in the present dreadful struggle—she had broken down laws which even barbarous tribes centuries ago honourably respected. Just compare such dreadful outrages upon law and honour as Germany committed every day with the behaviour of a noble race in New Zealand, the Maoris. The Maoris had desperate fights with British regiments, and showed the greatest heroism and bravery before they were subdued. They used to send word to the British soldiers when they were going to attack them! Now German culture had degraded Germany below the savage level, because the Germans knew well the crimes against all law and all humanity of which they were guilty; and the fact that they were brave, the fact that they were strong, and the fact that they were enlightened would only cover them with greater infamy in the years to come when future generations pronounced upon the war. This great nation of ours was never engaged in a more bloody struggle, but she was never engaged in a struggle which, to all mankind and for centuries to come, would bring greater glory upon her name; and in the victory which must come we might hope to see the energies and talents of mankind, not engaged in a bloody struggle to occupy some place in the sun, but to fill those large and unoccupied places in the glorious suns of human enterprise, human skill, and human love.

The vote of thanks was carried with acclamation.

The Author, in reply, said although he had tried to keep feeling out of the paper, in the background of his mind he had some very sad thoughts indeed. He owed more than he could say to Germany, and he hoped he would never be ungrateful for what he had learnt from his German teachers. But during recent years he had felt more and more alarm when he had gone to Germany to see the constant nervous tension in which people seemed to live, their inability to realise the great things which were being done in the world, and the great thoughts which were being spread in the world outside Germany. There seemed to be a self-centred strain, a self-satisfaction, and a readiness to take offence; and now the breach was to him unspeakably painful. It was for that reason he thought it better to keep all sentiment as far as possible out of the paper.

THE HARDWOODS OF PANAMA.

The cacique is a small tree growing about 45 feet high and a foot thick, in scattered clumps or thickets on the hills. It is comparatively rare, and the timber is generally considered the most valuable in the country, being durable, hard, impervious to insects, and very beautiful. The ground colour of the wood, when cut and aged, is a rich deep red, with black spots and stripes. The natives demand at least about 20*s*. for a cacique whipstock or cane, and such canes have been sold in New York for as much as £5, according to a recent report by the Sanitary Inspector of the Isthmian Canal Commission. There are probably about 100,000 trees of timber size in the country, and the value of the timber, aside from the cost of getting it out, would be about £1,400,000. The name of this tree is derived from the fact that the ancient Indian chiefs (caciques) used the wood for their sceptres, or batons of office. The ground wood is used by the natives as a styptic. There are three kinds of trees, referred to in common Central American usage, as "caoba;" all three occur in the higher parts of Panama. The first two, Guarea caoba and Carapa guianensis, attain a height of 100 feet or more. Their timber is so similar to Honduras mahogany, that it is equally valuable—about £18 per 1,000 feet. The Guarea caoba will run from 3,000 feet to 5,000 feet per acre, and the amount now standing in the country is valued at £36,000,000. The Espave, often 5 feet thick at the base, grows to a height of 80 feet to 120 feet, of which 40 feet from the base is clear. Some of the large branches are available for lumber. Some forests average fifteen large trees to the acre. The leaves are large, somewhat heart-shaped, light green, and very abundant. The Espave is prized so much by the natives as a shade tree, that they usually spare it in clearing for planting. They use the timber, however, for their canoes, many of which last for a generation or more. The wood is of a reddish bay colour, resembling mahogany, for which it is often mistaken. It is close grained, durable, and uniform in texture, and works readily. There are probably 1,500,000 of these trees in Panama. The timber is worth £16 per 1,000 feet, and the total value is about £26,000,000. The quayacan is somewhat smaller than most hardwoods, averaging 70 feet high and 2 feet thick, and branching 80 feet from the ground. The leaves are small and compound, and the greyish-black bark is rough and shaggy, with longitudinal furrows. The inflorescence is a mass of magnificent golden blossoms. The wood, hardest and most durable of the timbers of Panama, is akin to the lignum-vitæ of the West Indies. Railway ties of the quayacan have been in use on the Panama Railway for many years. It is so hard that holes had to be bored for the spikes. There are probably 1,000,000 of these trees in Panama, worth about £3,000,000. The laurel, 3 feet in diameter, grows on hillsides to a height of 100 feet. The bark is white. The wood is yellow, hard, fine grained, durable, and easily worked. There are probably more than 1,000,000 laurel trees in Panama, with an average yield of 1,000 feet per tree, and a total value of £12,000,000. The Santa Maria, or calapa, is a large evergreen, attaining a height of 100 feet or more, with more than 50 feet clear, and with a diameter at the base of about 3 feet. The bark is comparatively thin, mottled grey and black, and slightly rough. It peels from the wood readily. The wood is greyish white, as hard and elastic as hickory, and also similar to teak. It is durable, straight, and close-grained, takes a good polish, and splits longitudinally better than most tropical hardwoods. It was used by the Indians for bows, and is employed almost exclusively for palanquin poles. There is probably £14,000,000 worth of this timber in Panama.

SELF-BURNING LIMESTONE IN SYRIA.

In the district of Hauran, a volcanic district of Syria, south of Damascus, east of the Upper Jordan, a curious stone is found which might be described as a "self-burning limestone." At this place the rock lies in a stratum between ordinary limestone; it is of a greyish-black colour, and when freshly broken it has an odour of petroleum. The quarrying, according to the American Deputy-Consul at Jerusalem, who has lately visited the district, is easily done with primitive picks and other tools, as the rock is quite soft and full of seams. The stone is broken into small pieces with hammers and piled up against the bank of rock. A wall of the same material about two feet high is roughly laid up round the pile on three sides, making a pile of small stones eight to ten feet long, and nearly as wide, and two feet at the front, rising to nearly three times that height at the back where it lies against the bank. In building the wall around the pile small holes are left in which to start the fire.

When the kiln is ready to burn, a few small bunches of straw are placed in the holes mentioned, lit with a flint and steel, and in a short time the whole pile has ignited. The men then begin working on a new kiln while the other burns and cools. After about twelve hours of burning the stone has all become converted into lime, except the stones in the wall and the very top layer which are only about half burned. When cool the lime is air-slacked and sifted, to remove any pieces not thoroughly burned, which are thrown into a new pile to be fired again. The lime is white and said to make a very strong plaster, superior to the ordinary lime burned with brush, but sells at a much lower figure, because of the low cost of production.

COCOA-BEAN COATING IN TRINIDAD.

The practice of claying cocoa beans began in Trinidad about twenty years ago, and soon became prevalent throughout the island. It is now practised generally by the large estate owners, and is regarded as the best method of preserving the bean. When the cocoa bean is first taken from the pod it is enveloped in a thick white layer of tissue, and this tissue in the process of fermentation becomes shrunken, discoloured, and slimy. The former custom was to wash the slimy covering from the bean before drying, but this entailed much labour and reduced the weight of the bean. It also hastened the drying process, often to the injury of the kernel. It is also contended that washing renders the integument of the bean more brittle and liable to crack, in which event the bean would take up foreign scents and lose its own aroma. The clay wash was considered the best means of preserving the cocoa beans. The process is simple and rather primitive. According to the American Consul in Trinidad, the fermented beans, after being partially dried, are piled on the drying platforms, and pulverised earth, ferruginous and devoid of organic matter, is sifted over them. About one pound of earth is used to every one hundred pounds of wet cocoa beans. The beans are thoroughly stirred with wooden shovels and the earth adheres to the mucilaginous matter clinging to the integuments.

The beans are then spread out on the platform to dry in the sun. When drying is nearly completed they are piled in heaps and sprinkled with water until the whole mass becomes sticky. Then the labourers perform the so-called "dancing" act, by trampling the beans with their naked feet till the seed coats assume a glossy appearance, when they are again spread out in the sun until sufficiently dry. The object in claying the bean is to render it impervious to moisture, to prevent decay and to preserve the aroma of the kernel. Moisture encourages the growth of mould, which imparts an unpleasant flavour to the kernels and depreciates their market value. Abuses have crept into the process of claying, resulting in excessive claying in order to increase the weight of the beans. Instead of the average clay wash, one pound to one pound and a half of clay to one hundred pounds of wet cocoa beans, unscrupulous dealers have of late years been introducing as much as six to ten pounds of clay to the hundredweight.

It is said that the beans in their natural state will not take more than one pound and a half of clay to the hundredweight, but by the addition of glue and other foreign ingredients the coating of the beans will consume from six to ten pounds. Another object of claying, in addition to preserving the beans, is to render them uniform in colour, as a higher price is obtained when the beans do not vary in colour. All cocoa handled by jobbers and country dealers is sold to merchants of the city, and the latter, appreciating that the remedy rests with them, have recently refused to buy excessively clayey cocoa. This course has had its effect in reducing the quantity offered. The Agricultural Society of Trinidad, the Chamber of Commerce, and the Cocoa Planters' Association, realising the injury that may be done to the cocoa industry in Trinidad by the abuse of claying cocoa, have recently made a joint effort towards ending the practice, and have caused posters to be placed in public places in the city and in country districts giving warning that "if excessive claying be not discontinued, it will be necessary in the general interest of the colony to bring the matter to the notice of the Government, with a view to the introduction of legislation making excessive claying a punishable offence."

VEGETABLE IVORY EXPORTS FROM ECUADOR.

Increased purchases of vegetable ivory nuts for manufacture into buttons are being made from Ecuador. Take the United States, for example. Imports into that country during the year 1908 amounted to over 14,000,000 lbs.; in 1912 to 23,000,000 lbs.; and in 1913 to 29,000,000 lbs. These imports were nearly all derived from Colombia and Ecuador, the latter country alone furnishing nearly 17,000,000 lbs. in 1913. Tagua, the vegetable ivory nut, is the seed of the fruit of a species of palm tree (*Phytelephas macrocarpa*), which grows plentifully in the western or tropical region of Ecuador, Colombia, and the interior of Brazil. Queensland produces a similar but larger nut with a hole through its centre. The producing ports of Ecuador, in the order of their importance, for unshelled nuts are, according to the United States Consul at Guayaquil—Esmeraldas, Manglaralto, Bahia, Manta Cayo, Puerto Bolivar, Macara, Machalilla, and Guayaquil; for shelled nuts—Manta Guayaquil, Cayo, Machalilla, Manta, Esmeraldas, Macara, and Puerto Bolivar. The tagua obtained in Puerto Bolivar and Macara, the largest in size and highest in price, is brought to Guayaquil for export. Owing to political disturbances in the country, recent data could only

be obtained from the Province of Manavi and the vicinity of Guayaquil. From the first-mentioned district reports state that during the year 1913 there were received in the port of Bahia about 8,000,000 lbs. of tagua, of which quantity 4,755,100 lbs. were exported shelled, leaving about 3,244,000 lbs. of shells and discarded nuts to be thrown into the sea or used for fuel.

The percentage of defective nuts is difficult to estimate, since it depends entirely upon whether they have been picked from the palm or gathered from around it. Ripe nuts that have fallen to the ground are likely to be worm-eaten, especially if left for any length of time, whilst those picked from the trees are usually sound. A prominent exporter of Guayaquil states that worm-eaten nuts are not brought to that market, because exporters refuse to buy them. The defective nuts are separated at the haciendas and thrown into the river before the tagua is sent to Guayaquil, where any worm-eaten nuts found are removed, for otherwise the entire shipment is liable to become infected. About 250 tons thus disposed of at Guayaquil annually could, it is said, be purchased at a very low price, although the export duty amounts to about 5*s*. 6*d*. per 100 lbs. on shelled and about 3*s*. 4*d*. per 100 lbs. on unshelled tagua. Recent prices at which tagua was sold from the warehouses were about 14*s*. per 100 lbs. for the extra large tagua from Macara and Puerto Bolivar, for ordinary commercial nuts 12*s*. per 100 lbs., rejected nuts being offered by one exporter at 2*s*. per 100 lbs. To the above prices must be added the export duty and shipping expenses. There is at present in the Province of Manavi but one shelling machine in operation; in other parts of the Republic there are several. It has been stated that a former United States Minister to Ecuador has organised an industrial company with all the capital subscribed. The officials are to be in Manta, where a plant will be installed, the object of which is to square the nuts ready for cutting into buttons, etc., by removing all superfluous corners and parts, and then export the improved article. By so doing the freight expenses will be materially reduced, allowing a larger percentage of profit on the exported material.

THE DEVELOPMENT OF THE TEXTILE INDUSTRIES.

The Enemies' Goods—The patterns of Austrian and German cloths collected by the Board of Trade, and placed on public exhibition successively in London and Manchester, have attracted incomparably more attention than had the articles been placed on the market in the usual way, and probably more than their real importance warranted. Patently, the bulk of the exhibits came from the collection of a single merchant firm, whose name they bore, and these were amplified by indiscriminate contributions from other sources. Technically, the samples were not more educative than such as might be turned out of the pattern cupboards of many a shipping merchant in this country and not more representative. The exhibits afforded no serviceable index to the full range of fabrics produced in the two countries, and could not be held to represent even the main articles of production. The general absence of prices detracted from the utility of the display—an omission the more serious because price was in most cases the only material point at issue. Where prices were given no date was attached, and although the samples were undated the internal evidence of fashion seems to attribute them to a period not less than one or more than four years' distant. These considerable blemishes did not of course obliterate all interest, and in Manchester it was observable that visitors' examination of the articles was conscientious if brief.

Some Continental Cottons.—Specimens were shown of fancy cottons ornamented with mercerised stripes, and also of artificial silks. The production of similar goods employs some thousands of looms in the Bradford area, and in few cases could the duplication of the pattern involve any appreciable difficulty. Exception may be made of the warp-figured artificial silks, of which the production is too tedious to afford satisfactory wages to weavers who can get other work. It is perhaps not surprising that the cotton poplins shown in the exhibition should be perceptibly inferior to those manufactured here. A series of cotton trouserings in imitation of what the tailors call cashmere cannot be denied the merit of plausibility. The imitation is superficially excellent, the printed dots of aluminium powder simulate a woven silk stripe admirably, and the duplex printing of back and face are skilfully calculated to deceive. Granting that the wearer thoroughly understands that the goods are made to look at and not to wear, that their fine features will disappear in an absurdly short time and their smartness melt promptly into the shabbiness of rags, the articles may be approved of unstintedly. It is of some interest to note that the process of aluminium printing by which they are decorated was developed originally by a firm of Leeds lithographers and its use extended to English calico printers at large, by whom many million yards of cottons have been printed for more defensible uses than as trouserings. The absence of prices on these goods leaves it impracticable to make comparison with some not less handsome cotton and shoddy mixtures which are made in Yorkshire, and are a hundred times less likely to disappoint the customer. The more brilliantly finished cottons are distinct from the comparatively spineless tweeds and trouserings made from cotton waste, and obtainable, according to the tickets upon them, at some 5-10*d*. a yard. There is hardly a doubt that such cloths could be made here were it seriously worth the while of manufacturers. It may be thirty years since woollen tweed makers in the Colne Valley tried and abandoned the trade

in all-cotton goods, and there is the minimum of reason for questioning their choice. As recently as twenty years ago better imitations of worsted were made in all-cotton by various English makers whose interest led them into other fields. The truth is that the contentment of the consumer is not separable from the interest of the manufacturer. Long experience shows that the cloths which gave satisfaction in use are those for which the consumer comes back, and it is incontrovertible that for a certain range of purposes wool, even in its most debased forms, holds advantages denied to cotton.

Specimen Woollens.—The fortuitous character of the official collection is emphasised in many odd ways. "Spanish stripes," which were cloths of some moment in the days of the East India Company, engage nowadays only such interest as may attach to the sale of 4,000 to 5,000 pieces a year to Shanghai, with driblets possibly to the South American market. The goods are plain-woven woollen scarlets, embellished at the end of the piece by three successive strips of highly coloured piled mohair and a scroll of stitched lettering. The stitched addendum "Made in Germany" may have explained a prominence unwarrantable upon the ground of commercial importance. The inclusion of a handful of samples of union felts by no means overrates the strength of the Austrian felt industry, upon which British slipper-makers, for example, have depended so largely for supplies. Coals are carried to Newcastle with a vengeance when German patterns of crossbred wool dress serges are exhibited in England. The comment of an English woollen manufacturer upon a heap of cotton-warp meltons, inferior to those of Leeds, tweeds shabby in comparison with Colne Valley goods, heavy woollens of the Batley type, and of low-grade boiled-finish woollen goods, was at all events unflattering. The results attained in those classes afford nothing for English woollen manufacturers to copy, and if the general rule holds good in their case the products offer no advantage in price.

Upholstery Fabrics.—A disproportionately large place in the exhibition occupied by upholstery goods adds little to the knowledge that might have been gained at any time within a few years past by shop-window gazing at home. It is, however, instructive to know from one of the most eminent sellers of upholstery that not all the cloths hitherto imported from Germany have been of German manufacture. The stoppage of supplies during the war has singled out some of these quasi-German goods as French. Canvas printed or tamboured in new art designs from the Wiener Werkstatte is German enough in style to escape suspicion of French origin. Turkey towelling printed in broad stripes of black and grey with a white floral figure appeared in the exhibition as a furnishing fabric under a Lubeck trade-mark. It is possible that the sense of colour rather than the instinct for cleanliness is consulted in the jacquard figuring of towels intended for the toilet. The taste for terra-cotta and green striped towels, for heliotrope flowered and checked towels and for some similar floridities, more probably grew up on the Continent than in England. The export division of Manchester trade could doubtless match the brilliancy of certain orange, purple, green, and black calico prints, or the undistinguished common prints in which the supreme matter is one of price.

Typical German Goods.—Naturally, the exhibits included a variety of soft flannelettes labelled "eider reversible," and so on. The goods are not strange to English eyes, but those in the best position to commence their manufacture here evince no inclination to do so, and the reason lies elsewhere than in the want of capital or ability. Attempts which do not begin at the beginning with a certain blend of raw materials and a special method of spinning have hitherto failed, as they presumably always must fail, to duplicate this article. Hosiery may conceivably form the subject of a later exhibition to itself, although German hosiery developments are tolerably well known already to English traders. Some stockinette fabric was shown in Manchester, and in one specimen a net of cotton remained as the foundation with the wool existing as a furry fluff above and below it. A glove fabric exhibited was of the more interest for being shown in conjunction with the Bolton yarn from which it has been hitherto made in Germany.

Contrary Twists.—The direction, left-hand or right-hand, in which yarn is twisted, has effects larger than are always realised. As the direction of the twist controls the angle of the refraction of light it becomes possible to divide light and shade upon the plane surface of table-linens, where the fleeting play of light has given cause to sometimes fruitless speculations. Twist plays its part in increasing or diminishing the tendency of cloths to shrink after wetting and in promoting the durability of clothes. Contrary twists in stranded yarn bind and hold each other together. Attention to twists and some other details effects the crimping of a fabric, and the production consequently of a crape. As may be readily demonstrated, an extremely hard twisting in one direction sets up a strain contorting the whole thread and inducing it to fold upon itself. The feature last named has been availed of in making elastic surgical bandages without rubber, threads of hard right twist alternating in due rotation with threads of left twist, so that in a fabric of very open structure the interstices are taken up by the contortion. It may appear odd that so elementary a matter can form the subject of an apparently valid patent to use which English firms are contesting. The patent is that of a German, Teufel, and the applications in respect of it are made apparently more with a view to the weaving of elastic puttees than of bandages. The

applications seem to be the only ones made in connection with a purely textile matter since the opening of the war.

Kapok Fibre.—It has been reported for some years that extensive use has been made by the German naval authorities of the fibre kapok. The filaments are unicellular without the natural twist which befits cotton for spinners' purposes, and the fibre has been used mainly for stuffings. "Golden down" is the upholsterers' euphemism for cleaned kapok, and the feature that has disqualified it for spinning into thread has made its fortune as a filling for cushions. Kapok does not mat or felt in the same way as the recognised fibres for spinning. Reports of success attained in spinning kapok have come to hand periodically from different parts of the earth, and somewhat pointless reports in view of the fact that it pays to adulterate kapok with cotton, and that adulteration is too frequently undertaken. *Eriodendron anfractuosum* is its botanical name, and it is imported from Java and neighbouring countries. The virtue of kapok, from the naval point of view, is a buoyancy which is calculated to be many times greater than that of cork. Hence comes the use of the fibre in numerous life-saving waistcoats now offered for sale. Kapok is understood to be used upon German ships as a stuffing for lifebuoys and mattresses, and, except that it may be more inflammable than certain available alternative stuffings, there is nothing convincing to be said against its use for similar purposes in English practice.

CORRESPONDENCE.

THE DECORATIVE TEXTILE INDUSTRIES AND THE DESIGNER'S RELATION THERETO.

I was present at the meeting on the 17th inst., and heard Mr. Wilcock's paper, but the hour was already late, and I did not feel justified in prolonging the discussion.

It seemed to me that the author of the paper was hardly right in saying that the designer's name always remains unknown to the public. It is true that a large proportion of the purchasing public are indifferent in the matter, and do not know much about the characteristics of this or that artist's designs; but hundreds of designs in textiles have been sold with the artist's name appended as a recommendation.

Where the artist's work shows personality and independence, or some definite characteristic, his name becomes known and his designs inquired for —as in the case of William Morris, Lewis Day, Walter Crane; or, in the past, A. W. Pugin, W. Burges, Dr. C. Dresser, and many others, whose work, good or bad, was distinctive. On the other hand, the authors of designs which are merely variations, however excellent and useful, of what has been done before, but do not possess any personal quality, do not acquire personal recognition. They do not possess the quality which induces special notice in the purchasing public. The designer's name has often sold a material very unfitted for its immediate purpose, simply because the purchaser thinks that anything by that artist must be right. Even with pictures, many are bought on the strength of the painter's name rather than for intrinsic merit.

I certainly think that it is essential for a designer to understand the details of the manufacture of the material for which he is designing. He will otherwise put the manufacturer to needless expense, or find his designs unacceptable.

Especially is this a primary need in the case of designing for machine production, where the risks of loss are so serious. It is only with a correct knowledge of what the machine can or cannot do profitably that the designer of the finished material can do it or himself justice.

It is futile to exclaim against machinery. If the designer is a real artist, and knows the working of the machine, and *where its limitations lie*, he can produce that which will charm.

J. D. CRACE.

The aim of the Schools of Art is to provide a sound basis for all branches of Art. On this foundation the teaching of design is carried on. Much of the time of the students is taken up in learning to see accurately, in training the hand, and in studying objects of recognised Art value. This is the basis of all Art work, and that this fact is recognised is shown by the number of students sent to the schools by manufacturers and the design studios. Students are trained for all branches of Art, and specialisation is only possible at a later stage. On this foundation the teaching of design is carried on in the accepted paths and in the traditional styles. To teach the latest novelty and fashion of the moment would be to court disaster. The student would have nothing to fall back upon, and the design would be out of date before he was able to make any commercial use of it. No doubt those who run studios would be glad to have a fresh supply of students on "tap," well up in the latest craze. What would become of them afterwards? No teacher can prevent the immature student from taking round his designs and trying to get a start. Those who supply textile manufacturers with sketch designs at £1 each probably make more money than they would in a design studio. There is no difficulty with the present organisation of the schools in training the designers for textile industries. The need is for more studios to which they can go. In Paris there are a larger number than in London, with the result that the designer can change from one to another with more certainty of employment.

Regarding the Art masters, Mr. Wilcock complains that they are mostly men who have been unable to

make a mark with painting and have drifted into teaching. This is emphatically not the case, and if he will study the conditions of appointment and qualifications insisted upon by the Board of Education he will find that the training is a lengthy and comprehensive one, and must commence at a fairly early age. The 200 Art Schools in the kingdom are in charge of men highly trained for their particular work, with skilled assistants for various subjects, and it will usually be found that the design classes are in the hands of practical designers teaching part-time only: for instance, one school in London has two masters on the staff who are principally designers of textiles, and a third who occasionally does textile design. These three have recently sold designs to German firms.

Mr. Wilcock does not mention the number of designs done in his studio for abroad, but makes a point of the foreign designs bought by British manufacturers. To capture foreign trade it is necessary either to prepare the design specially for the market, purchase the design in the country for which the manufacture is intended, or make the design and manufacture of such excellence that it is beyond competition. The Arts and Crafts Society, by its exhibits abroad, has done much to popularise British designs. Designs for printed linens, chintzes, cretonnes and wallpapers were shown at their last exhibition. Mr. John Sanderson remarks that "Continental people, who were a little out of the common and desired something really nice, always used English wallpapers, and the same thing applies to the United States." Is none of the credit for this due to the Art Schools?

The statement of Mr. Wilcock that Germany has been supplying our great Wallpaper Combine with more than one-third of its annual demand for design is misleading. The Combine produces most of its designs in its own studios. It is one-third of those purchased, in addition to this, that comes from Germany.

In an address at Macclesfield, in 1909, Mr. Frank Warner speaks of the "real practical training the students receive now-a-days in Macclesfield, Manchester, and the leading Continental technical schools." Again, in 1912, speaking of the National Competition of Schools of Art, he says: "By its influence and attitude, always gentle and never dictatorial, it has promoted industrial Art training in this country in such a way that in a land which only a few years ago was almost barren of Art, we now have so much that is good and promising that, much as we may yet have to learn, we are not only no longer ashamed to meet the world in competition but, I believe, with the exception of France, there is no country which can excel or even equal us in artistic manufacture."

No doubt much remains to be done, but the schools are really working to give the students a good training so as to help the manufacturer, and no good will come from lecturers who imagine that the schools are not progressing with the times, and simply abuse them and the Art master. I will conclude by again quoting Mr. Warner:—

"Surely the obvious way successfully to meet such competition is to discover, through our technical schools, the most economical methods of manufacture, and through our Art Schools to impress upon our goods the best taste in form, design and colour. But this can only be accomplished if the manufacturers wake up to a true appreciation of the value of the work which is being done in some of the schools, and could be done in all of them, and therefore take advantage of the benefits which the community, aided by the State, has provided. It is true, as I have already pointed out, that the value of these benefits is sometimes leavened by the absence of the practical element in the teaching; but, in spite of that, the manufacturers would, with but rare exceptions, profit by employing the products of the Art Schools rather than those of their own training."

CHAS. A. EVA, A.R.C.A., Lond.

In support of Mr. Arthur Wilcock's remarks on the subject of the effective employment of the Art students from our Government and municipal schools, and the wisdom of bringing them into closer touch with trade, I should like to say that in 1837 our State School was founded at Somerset House with the definite purpose of encouraging the study of Art in relation to industry and manufacture, and even since then the Education Department, we are told, has endeavoured, in fits and starts, to advance this branch of work. We cannot, however, boast of much success. It is deplorable that a nation like ours should have allowed its natural instincts for the beautiful to lie fallow, and our industrial performances in this direction to go unco-ordinated and untrained, when we have gone ahead in so many other ways that contribute less to the amelioration and sweetening of daily life. There is no doubt that we owe something to Schools of Art; but what industry requires is men practised in design and its adaptation; it has little or no use for craftsmen who are too proud of their creations to carry out any design but their own, or to adapt themselves to the necessities of industrial production. The schools have failed to meet the requirements of industry in the important branch of Art teaching in practical conditions, which is the one that most affects the prosperity of the country. It is true that manufacturers have looked in vain to them for practical designers; broadly speaking, there is a lack of sympathy between the schools and the manufacturers: one has an artistic standard of its own, and apparently refuses to consider in a logical manner the calls of the other. Our trading competitors abroad have been very active, and, if we ever hope to advance as they have done, the application of Art to industry must be fostered with far greater energy than in the past.

W. G. PAULSON TOWNSEND.

OBITUARY.

Sir Charles Augustus Hartley, K.C.M.G., M.Inst.C.E.—Sir Charles Hartley died on the 20th inst. at the great age of ninety, for he was born in 1825. For many years he was the leading authority on matters connected with river engineering. In 1867 he reported on the River Scheldt, and in the same year he obtained a prize offered by the Emperor of Russia for plans for the enlargement of the port of Odessa. He advised on the improvement of the Mississippi; on the route for the Panama Canal; on the navigation of the Hooghly; the harbour of Madras; the port of Trieste; the Nile barrage; the improvement of the Don and the Dnieper, and many other rivers, including indeed the Thames. From 1856 to 1907 he was Engineer-in-Chief and Consulting Engineer to the European Commission of the Danube, and it was in the improvement of the Danube navigation that his principal reputation was gained. He was also, from 1884 to 1907, a member of the International Technical Commission of the Suez Canal. He was the recipient of numerous foreign orders awarded for his services as an engineer, and was the author of various important books on his own special subject.

Sir Charles was awarded the Society's Albert Medal in 1903 in recognition of his services in the improvement of river navigation, and in the same year he became a member of the Society. In the following year he was elected a Vice-President, and he held this office for three years. He was knighted in 1862, and made a K.C.M.G. in 1884.

James Spicer.—Mr. James Spicer died at Eltham, Kent, on the 22nd inst., in his seventieth year. He was the eldest son of Mr. James Spicer, senior, wholesale stationer, and, in common with his brother, Sir Albert Spicer, Bt., M.P., he assisted his father in founding the well-known firm of Messrs. James Spicer & Sons, Ltd., wholesale stationers, paper warehousemen, and paper manufacturers. In addition to his business activities he took a deep interest in a number of charitable institutions.

Mr. Spicer was elected a Fellow of the Royal Society of Arts last year.

GENERAL NOTES.

The Trade of Gambia.—Gambia is the smallest British colony in West Africa, lying on either side of the Gambia River between French Senegal and Portuguese Guinea, with an area of about 3,619 square miles. The principal industries are the cultivation of ground nuts, and, in the far interior, cattle-breeding. The present conditions as a result of the war will affect the prosperity of Gambia less than the other colonies or protectorates farther south on the coast, as the colony's products go principally to France and England. The increased volume of trade and shipping in 1913 over previous years is due to the influx of new French firms and the consequent competition in trade. The United Kingdom continued to furnish the greater amount of cotton goods and hardware, followed by France and Germany in the order of their importance. Rice came principally from Germany, France and Great Britain, Germany leading. Germany also furnished the greater amount of spirits (gin), followed by the United Kingdom and France respectively. France supplied the greater amount of sugar, followed by the United Kingdom and Germany respectively. Salt, all refined, was furnished by the Portuguese colonies. Tobacco, principally unmanufactured, was practically all furnished by the United States, and wine by France.

Indian Trade and the War.—A Press *communiqué*, issued in India, states that Mr. M. M. S. Gubbay, I.C.S., Collector of Customs, Bombay (on leave), has, as an experimental measure, been attached for a few months on special duty as Indian Trade Commissioner to the Board of Trade City Office, 30, Cheapside, London. In this capacity he will assist in finding outlets in the United Kingdom for Indian exports of raw and manufactured articles which in normal years go to Germany and Austria-Hungary, or to other parts of the Continent, and which have lost their market owing to the war.

Eau de Cologne, a French Product.—"La Chambre Syndicale de la Parfumerie Française" has expressed the opinion that the title "Eau de Cologne," by which this popular perfume has been known for more than two hundred years, should not be altered. It is essentially a French product, even if "made in Germany." It is composed of ingredients produced in France, bears a French name, and is manufactured by a process perfected in France.

The "Côte d'Azur" at the San Francisco Exhibition.—Notwithstanding the war, and the fact that many of the principal hotels have been turned into hospitals filled with wounded, the hotel industry on the French Riviera will be well represented at the San Francisco Exhibition. The pavilion of the "Côte d'Azur" will occupy more than half the space allotted in this department to France. Upward of five hundred of the principal hotels on this coast will be represented. The various sections will embrace every subject connected with hotel administration, from architecture to sport, golf and tennis included. The principal beauty spots, the varied attractions and places of historical interest will be well illustrated by magnificent collections of photographs. The fine panorama representing Monaco and Monte

Carlo, as viewed from the sea, which figured at the Paris Exhibition in 1900, will also be shown, together with dioramic views of Nice and Mentone. These exhibits have just been shipped, *viâ* the Panama Canal, by the "Jason" of the United States Navy.

"DEFENDERS OF THE EMPIRE."—Messrs. Raphael Tuck have forwarded for review a packet of their postcard reproduction of Mr. H. Payne's picture of representative units of our land and sea forces. The brilliant and familiar uniforms of old, reproduced in their actual colours, are naturally adopted by the artist in preference to the monotonous, if serviceable, khaki, and the result is a bright and attractive picture. The types include the Royal Horse Artillery, Royal Field Artillery, Household Cavalry, Lancers, Hussars, Foot Guards, Highlanders, Infantry of the Line, Yeomanry, Territorials, Sikh Infantry, Bengal Lancers, N.S.W. Lancers, New Zealand Mounted Rifles, Royal Canadian Infantry, South African Rifles, Marines, and Boy Scouts. In the background we have a "Dreadnought," cruisers, destroyers, submarines, and torpedo-boats, while in the air are shown an airship, a hydroplane, and a monoplane. The profits of the sale are to be devoted to the Prince of Wales' National Relief Fund.

COMMERCIAL MUSEUM IN TENERIFFE. — The Superior School of Commerce, an official institution of Teneriffe, is installing a commercial museum, having the character of a permanent exhibition of products of various countries. Merchants and manufacturers are invited to send samples of their wares or products, accompanied by such information as to prices, freights, etc., as it may be convenient to give. The school offers to reimburse exhibitors for the cost of sending samples. Practically all the young men of Teneriffe destined to commercial careers take a course in this institution, and it is expected that a creditable exhibition of foreign products constantly before the eyes of the merchants of the Canary Islands will be of great benefit to their trade. It may be added that the Canary Islands are highly prosperous, and that in them there is some demand for almost every article entering into modern commerce, except such as are suitable only to cold countries.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock (except where otherwise announced):—

MARCH 3, at 4.30 p.m. — WILLIAM POEL, "Shakespeare's Profession." SIR SQUIRE BANCROFT will preside.

MARCH 10.—J. W. GORDON, K.C., "Patent Law Reform and the War." DUGALD CLERK, D.Sc., F.R.S., will preside.

MARCH 17. — H. M. THORNTON, "The Industrial Uses of Coal Gas." SIR CORBETT WOODALL, D.Sc., M.Inst.C.E., Governor of the Gas Light and Coke Company, will preside.

MARCH 24, at 4.30 p.m.—LADY LUGARD, "The Work of the War Refugees' Committee." COLONEL SIR THOMAS H. HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Chairman of the Council, will preside.

APRIL 14. — T. THORNE BAKER, "The Industrial Uses of Radium."

INDIAN SECTION.

Thursday afternoons:—

MARCH 18, at 4.30 p.m. — LIEUT.-COLONEL A. C. YATE, I.A. (retired), "The Indian Army." The RIGHT HON. VISCOUNT BRYCE, O.M., D.C.L., LL.D., F.R.S., will preside.

APRIL 15, at 5 p.m. — PERCEVAL LANDON, "Basra and the Shatt-ul-Arab." The RIGHT HON. EARL CURZON OF KEDLESTON, G.C.S.I., G.C.I.E., will preside.

MAY 13, at 4.30 p.m.—M. M. S. GUBBAY, I.C.S., "Indian Trade and the War."

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MARCH 2.—DAVID LINDSAY (Leader of the Elder Scientific Exploration Expedition), "The Northern Territory of Australia: Past, Present, and Future." The RIGHT HON. SIR GEORGE HOUSTON REID, G.C.M.G., D.C.L., K.C., High Commissioner for the Commonwealth of Australia, will preside.

MAY 4.—S. CHAS. PHILLIPS, M.S.C.I., "The Empire's Resources in Paper-making Materials."

Dates to be hereafter announced:—

FRANK BAINES, M.V.O., Principal Architect in charge of Royal Palaces, "The Restoration of Westminster Hall."

E. W. HULME, "Patent Law."

ROGER FRY, "Post Impressionism in Design."

C. H. SHERRILL, "Ancient Stained Glass."

A. S. E. ACKERMANN, B.Sc., Assoc.M.Inst.C.E., "The Utilisation of Solar Energy."

CHARLES R. DARLING, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

AUGUSTUS VERNON HARCOURT, D.C.L., LL.D., D.Sc., F.R.S., "On an Economical and Smokeless Grate, and on the Measurement of the Efficiency of Open Grates."

ALDRED LECTURE.

Thursday afternoon, at 4.30 o'clock:—

MARCH 11.—M. PAUL LAMBOTTE, Directeur des Beaux-Arts au Ministère des Sciences et des Arts de Belgique, "L'évolution de l'école Belge de Peinture (1830–1900)."

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

M. H. BAILLIE SCOTT, "House Building—Past and Present." Three Lectures.

March 15, 22, 29.

DAVID SOMMERVILLE, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

FOTHERGILL LECTURES.

Monday evening, at 8 o'clock:—

PROFESSOR VIVIAN B. LEWES, F.I.C., F.C.S., "Motor Fuel." Three Lectures.

Syllabus.

LECTURE III.—MARCH 1.—"*Cracked*" *Spirits.* The effect of degree of temperature used—The use of water or steam—Surface action and its supposed effect—Processes in use—The utilisation of gases in solution to increase vapour tension—The steam engine *versus* the internal-combustion engine for motor traction—Conclusions.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 1...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Fothergill Lecture.) Professor Vivian B. Lewes, "Motor Fuel." (Lecture III.)

Victoria Institute, Central Hall, Westminster, S.W., 4.30 p.m. Professor A. Fowler, "The Spectra of Stars and Nebulæ."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, Society of, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 7.30 p.m. Lieutenant R. W. A. Brewer, "Running Costs of Motor Vehicles."

Chemical Industry, Society of (London Section), at the Chemical Society, Burlington House, W., 8 p.m. Discussion on Mr. J. J. Eastick's resolution "That in the opinion of this Meeting representing the London Section of the Society of Chemical Industry, the Council of the Society should petition the Government to take such steps as will tend to the permanent production and refining within the Empire of Sugar sufficient for the Empire's consumption."

Electrical Engineers, Institution of (Local Section), Mining Institute, Newcastle, 7.30 p.m. Mr. C. P. Sparks, "Electricity applied to Mining."

TUESDAY, MARCH 2...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4.30 p.m. (Colonial Section.) Mr. D. Lindsay, "The Northern Territory of Australia: Past, Present and Future."

Japan Society, 20, Hanover-square, W., 8.30 p.m. Mr. W. Gowland, The Metals and Metalwork of Old Japan."

Royal Institution, Albemarle-street, W., 3 p.m. Professor W. J. Pope, "Colour Photography—Scientific Applications: Photographic Appreciation of Colour in Monochrome." (Lecture I.)

Alpine Club, 23, Savile-row, W., 8.30 p.m. Mr. N. S. Done, "Some Common(-)Places."

Roman Studies, Society for the Promotion of, at the Society of Antiquaries, Burlington House, W., 4.30 p.m. Mr. J. Curle, (*a*) "The Production of Samian Ware and its Development"; (*b*) "A Note on a Visor Helmet from Nijmegen, Holland."

Rontgen Society, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 8.15 p.m. Mr. A. Fleck, "The Chemistry of the Radio Elements."

WEDNESDAY, MARCH 3...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4.30 p.m. Mr. W. Poel, "Shakespeare's Profession."

Civil Engineers of Ireland, Institution of, 35, Dawson-street, Dublin, 8 p.m.

Public Analysts, Society of, at the Chemical Society, Burlington House, W., 8 p.m. 1. Mr. S. W. Bridge, "The Soluble Chlorides and total Chlorine in some English Cokes." 2. Mr H. Hawley, "The Routine Detection and Estimation of Boric Acid in Butter." 3. Mr. T. E. Wallis, "The Structure of Pepper—some new features." 4. Mr. A. de Waele, "The Occurrence of Chlorine in Coal."

Electrical Engineers, Institution of (Students' Section) Victoria-embankment, W.C., 7.45 p.m. Discussion on "The Applications of Electrical Engineering to Warfare." 1. Mr. P. R. Coursey, "Communication, Wireless, etc." 2. Mr. S. G. Killingback, "Laying and Firing Mines." 3 Mr. E. L. M. Emtage, "Searchlights and Projectors." (Local Section.) The University, Birmingham, 7.30 p.m. Mr. C. P. Sparks, "Electricity applied to Mining."

Royal Archæological Institute, at the Society of Antiquaries, Burlington House, W., 4.30 p.m. Mr. G. C. Druce, "The Sciapus and other Abnormal Human Forms in English Church Carvings."

THURSDAY, MARCH 4...Geographical Society, Kensington-gore, W., 5 p.m. Professor J. W. Gregory, "Suess's Classification of the Eurasian Mountains."

Royal Society, Burlington House, W., 4.30 p.m.

Linnean Society, Burlington House, W., 5 p.m. 1. Messrs. J. A. Wheldon and W. G. Travis, "The Lichens of South Lancashire." 2. Mr. A. W. Hill, "The Germination of *Marah* (*Echinocystis Marah*, Cogn.)." 3. Dr. Marie Stopes, "New Types of Stem-anatomy in *Cycadeoidea*, and a well-petrified new species." 4. Mr. W. E. Collinge, "Description of a new Genus and Species of Terrestrial Isopoda from British Guiana."

Chemical Society, Burlington House, W., 8 30 p.m. 1. Messrs. O. C. M. Davis and F. W. Rixon, "Steric influence. Static and dynamic." (Part II.) 2. Mr. P. C. Rây, "Interaction of dimercuriammonium nitrite and the alkyl iodidesnascent mercurous nitrite." 3. Mr. H. D. Dakin, "The constitution of allantoin and allied substances."

Royal Institution, Albemarle-street, W., 3 p.m. Sir H. Warren, "Poetry and War." (Lecture I.)

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Dr. G. H. Rodman, "On Pollens, and the Fertilisation of Flowers."

Concrete Institute, 296, Vauxhall Bridge-road, S.W., 7.30 p.m. Mr. R. G. Keevill, "Some Notes on Wind Pressures."

FRIDAY, MARCH 5...Royal Institution, Albemarle-street, W., 9 p.m. Professor E. B. Poulton, "Mimicry and Butterflies."

Geologists' Association, University College, W.C., 8 p.m.

SATURDAY, MARCH 6...Royal Institution, Albemarle-street, W., 3 p.m. Professor Sir J. J. Thomson, "Recent Researches on Atoms and Ions," (Lecture III.)

Journal of the Royal Society of Arts.

No. 3,250. VOL. LXIII.

FRIDAY, MARCH 5, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, MARCH 10th, 8 p.m. (Ordinary Meeting.) J. W. GORDON, K.C., "Patent Law Reform and the War." DUGALD CLERK, D.Sc., F.R.S., will preside.

THURSDAY, MARCH 11th, 4.30 p.m. (Aldred Lecture.) M. PAUL LAMBOTTE, Directeur des Beaux Arts au Ministère des Sciences et des Arts de Belgique, "L'évolution de l'école Belge de Peinture (1830–1900)." LORD SANDERSON, G.C.B., K.C.M.G., Vice-President of the Society, will preside.

The lecture will be delivered in French.

Further particulars of the Society's meetings will be found at the end of this number.

FOTHERGILL LECTURES.

On Monday evening, March 1st, PROFESSOR VIVIAN B. LEWES, F.I.C., delivered the third and final lecture of his course on "Motor Fuel."

On the motion of the Chairman, LIEUT.-COLONEL ALLAN J. C. CUNNINGHAM, a vote of thanks was accorded to Professor Lewes for his interesting course.

The lectures will be published in the *Journal* during the summer recess.

COLONIAL SECTION.

Tuesday afternoon, March 2nd; The RIGHT HON. SIR GEORGE HOUSTON REID, G.C.M.G., D.C.L., K.C., High Commissioner for the Commonwealth of Australia, in the chair. A paper on "The Northern Territory of Australia: Past, Present, and Future," was read by Mr. DAVID LINDSAY (Leader of the Elder Scientific Expedition).

The paper and discussion will be published in a subsequent number of the *Journal.*

PROCEEDINGS OF THE SOCIETY.

TWELFTH ORDINARY MEETING.

Wednesday, March 3rd, 1915; SIR SQUIRE BANCROFT in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Misra, Gadadhar Prasad, 193/2, Harrison-road, Calcutta, India.

Park, Kendall, 50 Calle Ballester, San Gervasio, Barcelona, Spain.

The following candidates were balloted for and duly elected Fellows of the Society:—

Horn, Wilbur F., M.A., Carlisle, Pennsylvania, U.S.A.

Mayeda, T., Shimboricho, Shiba, Tokyo, Japan.

Myers, Fred L., Kensington-place, North-street, Kingston, Jamaica, British West Indies.

Salur, Raja of, Fort Salur, Vizagapatam District, Madras, India.

The paper read was—

SHAKESPEARE'S PROFESSION.

By WILLIAM POEL.

It is with some diffidence that I ask those assembled here this afternoon, who have spared a little time in days of stress and strain, to consider with me, in the name of Shakespeare and in the interests of the profession to which he belonged, the present condition of the English theatre. The apathy of Englishmen towards the art of the drama is due to the conviction that in the matter of amusement the public is supplied with what it wants, and that what it gets is the best of its kind. This, however, is as illogical an argument as it would be to say that every smoker gets the tobacco he most appreciates, even if he can afford to buy the best in the market. The fact that Government legislation became necessary in order to prohibit the adulteration of food, suggests that customers

do not always receive, in return for their money, an article bearing a genuine label. It is within the memory of most of us that, in the poorer districts of London, for many years margarine was sold under the name of "fresh country butter." Perhaps, too, shopmen trifle with their customers to a lesser extent than those who provide entertainments. What, for instance, can be more misleading than the following paragraph, which surely was inspired by a theatrical manager and found its way into the newspaper, more in the manager's interest than in that of the public: "The —— Theatre, as a popular priced house playing *the highest class attractions*, is meeting with *convincing* success. Last week Mr. Brandon Thomas and company, in 'Charley's Aunt,' played to huge audiences." Long ago, Schiller pointed out that the public must not be blamed for the quality of the drama which is presented before it, for he wrote:—

"The assertion so commonly made that the public degrades Art is not well founded. It is the artist that brings the public to the level of his own conceptions; and in every age in which Art has gone to decay it has fallen through its professors. The people need feeling alone, and feeling they possess. They take their station before the curtain with an unvoiced longing, with a multifarious capacity. They bring with them an aptitude for what is highest, they derive the greatest pleasure from what is judicious and true; and having these powers of appreciation, if they have once tasted what is excellent, they cannot be satisfied with inferior productions."

Nor do I stand alone in claiming the right to challenge the continuance of the present state of affairs with regard to our theatres. Frederic Harrison, the historian and critic, has said on the public platform: "I do not know what blight has fallen on the English theatre that the public will not look at anything really tragic. No manager would to-day accept either 'Lear' or 'Othello' if it were a new work by an unknown man." More recently Mr. John Palmer, the dramatic critic of the *Saturday Review*, has said: "The theatre has no real connection with life. It cannot even be said to be a mirror before the public face, as that face appears in its least exalted and exacting moments. Rather it has contrived a monstrous caricature of the public face, which the public has been induced to recognise as its own in the absence of anything in the nature of a portrait." It would be easy to go on quoting criticisms of a similar character; but I would rather point to the fact that it is not only the theatre on which a blight has fallen, for Mr. Thomas Beecham, in a letter written to the *Daily Chronicle* a few days ago, refers to the future development of music and says: "Little will here avail but a complete mental right-about-face on the part of the public and player alike; nor do I think this the time for soothing words. To-day we have an opportunity for reconstructive activity, such as is never likely to come our way again; but before the rebuilder makes his appearance the critic and iconoclast must plead measure of licence . . . and, for the life of me, I cannot see why a man, whenever nowadays he decides on telling the truth, should at once be accused of following in the wake of Mr. Bernard Shaw."

It is in the spirit of these words that I ask for your indulgence, while I endeavour, to the best of my limited ability, to indicate how, in my opinion, commercialism to-day has injured Shakespeare's profession.

To begin with, if I am to succeed in persuading you that when we visit the theatres we do not get proper value for our money, I must first explain what I mean by proper value. In the autumn of 1913 I travelled over the Continent, with the object of making some personal acquaintance with the theatres abroad, and my tour extended from Amsterdam to Vienna, *viâ* Berlin, and then through Munich to Paris. I had made a similar tour some twenty years previously, and need scarcely say that I found in my second visit some improvements to admire and some things to regret.

The German stage in 1913 had no great actors—a shortcoming which, perhaps, was not peculiar to that country. If it could be said that acting generally had improved, then the loss to the stage of those pre-eminent in their calling might have passed unnoticed. But there was then in Germany no company of actors of marked reputation; none, for instance, to approach in all-round talent that of the once celebrated Saxe-Meiningen troupe. As different reasons are put forward by way of explanation, it is worth while, in the interests of dramatic art, to examine them.

Some thirty years ago national theatres maintained a certain standard of acting which perhaps found the fullest recognition at the Théâtre Français. Nor had this standard altogether disappeared. In 1913 we still found it in Amsterdam, in Vienna, and at Petrograd—as, for instance, in the acting of that great artist M. Chaliapine. Then at the municipal theatre in Amsterdam actors still sustained their traditions, and the picture background did not wrest the attention from the figures in the play. The artists showed restraint, and had complete

control over the methods by which they expressed their art. With them it was not enough for an actor to be natural or to appear to be natural, but to be able to create various types of living men and women who did not resemble each other in speech, in action, temperament, or capacity.

In Vienna the Burgtheater and the Volkstheater in 1913 retained a supremacy for style which was especially evident in the art of stage management, and which had a distinction and finish not to be found in the German theatres. The spontaneity with which the action was sustained was remarkable, while the supernumeraries were moved and grouped with admirable judgment and skill. At the Volkstheater comedy was acted with an apparent ease which gave additional charm to its vivacity and humour. Nature, probability, and good taste were never overreached, while the actors showed more than ordinary observation and inventive faculty. These Viennese artists, besides, were particularly successful in creating "atmosphere": for whether the environment was the palace, the monastery, or the office, the characters gave the impression of being born and bred in their surroundings. Thus every play had its vivid portraiture. Even a dull play, in the hands of these excellent actors, ceased to appear dull, for it was always fresh in interesting detail, in colour, and in movement.

Notwithstanding the excellent acting at Vienna and Amsterdam, it must not be inferred that in 1913 Germany was behind Austria or Holland in its achievements on the stage, but the public of Berlin and Dresden was drawn to the theatre with other intentions than to enjoy the art of the actor. At Leipsic it was said that Reinhardtism—if it is pardonable to invent such a word—had made good acting no longer possible. If there were any truth in a statement which was obviously exaggerated, it meant that public interest, for the moment, was more centred on the art of the producer than on that of the actor. It is not an uncommon notion that shortage of good actors is occasionally inevitable. Even admitting that actors are born and not made, still, when exceptional talent is not wanted on the stage, it is not likely to find its way there. To give an instance, Dr. Gerhart Hauptmann's new staging of Schiller's play "Wilhelm Tell," at the Art Theatre in Berlin, was, in its setting, perhaps, the finest achievement ever seen on the stage. The walls of the theatre disappeared, and the spectator was confronted with the mists and the mysteries of the mountains. But scenic illusion of this kind has one serious drawback—it leaves little place for the actor's art. In sight of the wonderful panorama which confronted the spectator, it was no longer necessary to present Schiller's play through the words of the poet or with the help of the actor. To take another instance, Professor Reinhardt's reputation is deservedly great as a producer, and every new staging for which he is responsible arouses interest throughout the whole of Germany. This does not mean that Reinhardt cares only about staging. He is himself too sound an actor to overlook the importance of the actor's art; but his methods do not tend to raise the standard of acting. The perfect balance maintained between the acting and the staging of "The Living Corpse," in Reinhardt's production of Tolstoy's play, was noteworthy, and Signor Moissi's acting of the part of "Fedja" was both effective and moving. Yet the performance generally was more an illustration of clever realism than one of creative art.

Most theatres in Germany in 1913 were experimenting with backgrounds, sometimes using curtains and the apron platform, when Shakespeare's plays were given, and for other plays building the most elaborate settings on the revolving stage. Meanwhile, actors complained that their theatres were being turned into huge mechanical boxes, which provide the producer with every possible contrivance for getting "atmosphere" on to the stage or a quick change of scene, and yet in reality these contrivances only separated the actor more and more from his audience and from the natural conditions under which his art thrived. Now and then, in these new-fangled theatres, an artist who had more than ordinary mastery over his speech and his gesture would capture for a few moments the undivided attention of the audience; then background, lighting, and stage, as if by magic, vanished from the spectator's mind because the audience was under the sway of the poet's words and the actor's emotions. Stage illusion, said the elder Coquelin, was essentially the actor's, and not the painter's, business. With the help of the author's words he should conjure a living scene, a mental picture of moving ideas, which must be as vividly realised by the spectator as by the speaker, and which must stand out from the background as a thing apart from it.

There can be no doubt that German actors had been for some time in a nervous and restless mood, and realised that they were working under strained and artificial conditions.

Since Court and municipal theatres have had to compete with private theatres the standard of art had been lowered. At the Royal Opera Houses "Madame Butterfly" and "La Tosca" have been added to the play-bill, and at the Court theatres mere scenic plays or patriotic farces were often given, where the actor was hampered in the use of his art by the wooden figures he impersonated. On the other hand, the Art theatres were interested in methods of production of a Gordon Craig kind, or in dramas by the most modern poets; while the people's theatres perhaps secured the best repertory of plays and the cleverest actors. At the same time, it must not be inferred that Germany in recent years has been losing ground in her determination to maintain theatres which should be homes of Art. In this respect in 1913 she easily stood first, with France, perhaps, no longer a competitor; while the American and English theatres were still in the grip of financiers who took no interest in the drama as an art.

I will now give you a list of the plays that I saw during my brief stay in a German town not much larger than Manchester. Hamburg, which may be said to include Altona, the adjacent town, has a population of just over one million. It has several well-managed theatres, but the bill of fare that counts in drama may be said to be provided at four playhouses, although the Schiller Theatre, where I saw acted "Wallenstein's Camp" and "The Piccolomini," would in its class rank with our own Lyceum in its present days. The town Opera House and the town Altona Theatre were under one direction, and had a subvention to the extent that they did not pay any rent or any charges for water or gas. The Hamburg "German Playhouse," a very large theatre, and "The Thalia," a smaller one, received no subvention, and were expected to pay a small interest on the capital subscribed by some rich men of the town, whose object was to secure for themselves and their following more elasticity in the choice of plays and in the method of their presentation than could be possible at the Opera House and Altona Theatre.

I arrived in Hamburg on a Sunday afternoon, and I remained in the town eight days; and, omitting all reference to the Opera House, where the patrons of grand drama were provided with a change of bill nightly, I saw the following plays:—

Sunday.

German Playhouse . "Behind the Walls," a Jewish play.

Monday.

Altona Theatre . . "Intrigue and Love," Schiller.

Tuesday.

German Playhouse . "Clavigo," Goethe. / "The Accomplices," Goethe.

Wednesday.

Altona Theatre . . "Faust," Goethe.

Thursday.

German Playhouse . "Love's Labour's Lost," Shakespeare.

Friday.

German Playhouse . "Twelfth Night," Shakespeare.

Altona Theatre . . "Comedy of Errors," (Second piece) Shakespeare.

Saturday (10.30 *a.m.*).

Altona Theatre . . "Romeo and Juliet," (Dress rehearsal) Shakespeare.

Saturday (8 *p.m.*).

Schiller Theatre . . "Wallenstein," Schiller.

Sunday.

Thalia Theatre . . "Lulu," a new play, (Matinée) Wederkinde.

Thalia Theatre . . "Comrades," Strindberg.

The staging in all these plays was a work of art, and complete to the smallest detail. If the presentation of "Love's Labour's Lost" had been seen in London it would have been the talk of the town and would have had a run for over a hundred nights. The acting at all the theatres, if not great, was remarkable for its uniformity, and for the ability each actor had to create character. It must then be admitted that, for the size of the town, the list of classic plays presented in Hamburg in one week was a creditable one. Of course, this list does not exhaust the plays acted during the week; they are only those at which I was present.

To carry out this varied programme, the organisation of the theatre must be highly efficient. In the German playhouses are many officials in black coats and starched collars, and the offices are well furnished with every requisite which an important place of business can require. Work begins at nine in the morning and continues until midnight, although there is some cessation of duties between three o'clock and six o'clock for rest and food. When a new piece is produced, for which time has to be found, in addition to the daily routine that the week's repertory demands, then work of some kind is going on in the building all night as well as all day, and this amazing industry lasts throughout the season, from the first week of September to

the end of May, while in the Christmas-week time has to be found to revive special fairy plays for the young people during the afternoons, in addition to the night's repertory. Without, therefore, a large and capable staff, including several producers and heads of departments, and a director who combines much professional knowledge with business aptitude, the work of the theatres on the Continent could not be done at all, for the loss of half-an-hour in the scheduled time-table would throw the whole day's work out of gear. In Hamburg, too, the curtain rises to the second advertised on the bills, and the play ends at the time indicated on the programme. It can be easily understood, then, that there is no room in any department of the theatre for the laggard, the pleasure seeker, or the physically unfit. They drop out of its machinery from inability to keep up with its duties, because the actor, besides his work in the week's repertory, will be called upon to prepare an important part in a new play, of which he is expected to give a finished performance after some six rehearsals. It is not, then, strange that the actor who has played a long part on one night is glad to escape from the fatigue of his labours by undertaking a small one the next night, for he has abundant opportunities during the season of showing both the management and the public the scope of his talents. And after nine years of incessant toil, if he is worn out and no longer able to keep up his efficiency, he can retire on a small pension, to the capital of which every artist contributes who enters a theatre in Germany, whether he is earning £1 a week or £100.

As the Opera House and Altona Theatre are both under one direction, there are some eight hundred persons receiving salaries, while the subscribers for the season will number more than half a million, and many of these can, for the small sum of 18*s*., secure a reserved seat, which will enable them to see fifteen plays of one series during the season, and choice can be made of the modern, the classic, or the Shakespeare series. There is far more elasticity, too, about the box office in Hamburg than in London. There are the "little prices" (4*d*. to 6*d*.) charged for Sunday afternoons or on *fête* days; there are the "ordinary prices" for short plays; there are the "middle prices" for "Faust" and "Romeo and Juliet," and there are the "great prices" for grand opera, or when it is the first night of a new piece. Then the time of beginning the play varies: "Love's Labour's Lost" begins at eight o'clock and is over at ten o'clock; "Twelfth Night" takes half an hour longer. "Romeo and Juliet," given in nineteen scenes, lasts from seven o'clock until twelve o'clock, and so does "Faust" with its twenty scenes. The audience, moreover, in its behaviour is faultless, and custom here is also law. You must not take your stick or cap into the auditorium with you. You must be in your place before the curtain rises. You must not applaud your favourite actor when he first appears on the stage, nor when he leaves it in the middle of a scene after a clever piece of acting or declamation. You may titter, in the approved Shaw manner, but not laugh outright at the jokes and, above all, you must listen and not miss a word of what your author has to tell you, which he often does at considerable and almost unnecessary length.

The limits of this paper will not allow of a detailed criticism of plays and actors. To speak of my individual preference, I was much struck with the spirit of romp and farce with which the "Comedy of Errors" was rattled through; the whole of it was acted in one setting, and in a little over an hour, as it would have been done in Shakespeare's day; but the archaic and grotesque costumes, I thought, removed the play too far from actual life. The grace and beauty of the scene, costumes, and lighting in "Love's Labour's Lost" I shall never forget, nor yet the perfect balance and restraint of the actors in the Jewish play, and in "Comrades." But what is especially noticeable to the Englishman is the catholicity of taste shown by the playgoer who is called upon to accept so varied a programme. It is impossible to conceive of a Hamburger disliking Shakespeare or Goethe because he likes Strindberg and Schnitzler; his taste is wholesome. To suppose that the town could run mad over one particular author or play, or even actor, seems out of the question.

As regards the people's theatres in Germany, they have a standing of their own due to the character of the audience which is attracted, and which apparently is progressive in the best sense of the word, in so far as it looks to receive from the theatre not only amusement, novelty, morality, but also expects to obtain from it a broader outlook on life; and while these theatres keep the playgoer in touch with Goethe, Schiller, and Shakespeare, they also include in their repertory every modern writer who holds the position of being an accredited dramatist, namely, one who can portray character and incidents which reflect life and enable the onlooker to understand and

appreciate the realities of existence. That is to say, you cannot see in the people's theatres in Germany a single play of the class which appeals to the bulk of the working-classes in England, nor ever see there a play such as "The Great King," which I saw acted at the Royal Court Theatre in Berlin, on what was called a patriotic night. Here the audience was shown Frederick the Great, either playing on his flute or astride his charger; it was an altogether silly affair. What was also noticeable about these people's theatres was the representation in German of the best plays of our own dramatists, such as Shaw and Galsworthy. In Germany, then, there seemed to me to be a people's theatre which fully justified its existence. To watch the workman at the Volkstheater in Berlin, was to appreciate how much the German artisan was in advance of the English mechanic in appreciating the advantages of knowledge. Education through the theatre is so well recognised by the working-classes in Berlin, that they have become a society of playgoers numbering ninety thousand, and recently they have laid the foundation-stone of a new theatre there. For some years now they have been an organised body supporting a theatre with a subscription which amounts to about 4*d.* a performance. Now, what does this mean? That, without the advantages of a college education, the workman in Berlin may be said through his theatre to have a knowledge of the best minds from Æschylus to Ibsen; whereas the English artisan, though enjoying far greater privileges as a citizen, is yet so ignorant of life outside his own political horizon that he really believes that all that is necessary to bring about the millennium is that every living being should be able to think and act exactly as he does himself.

It is interesting to turn from a study of the Continental theatres to those in America, and as it is about ten years since I was on the other side of the "big pond," I must for my information refer you to *The Stage Year Book*, an annual publication which reflects very great credit on the editor, Mr. L. Carson, because in this volume the reader will find well-written summaries by first-class experts of the year's drama, both on the Continent and in America. On the last page of Mr. Denny's article on "The Year's Drama in America," written for the year 1914, is the following paragraph:—

"And so the worst year on record (1913) closed with depleted exchequer in many instances, bankruptcy in others, while never before has it happened that so many actors have been idle at this time of the year, when usually every available artist is occupied. Nor is this the worst phase of the case, since managers have scarcely an attraction that they can count upon to take them safely to the summer, or one that can offer any very great prospect for the road when the present pieces have to be called in."

Then in Mr. Denny's article on "The American Stage," published this year, the opening paragraph states that:—

"The past year (1914) may be looked upon as the most disastrous of any to date, for in no previous year can one remember such general dissatisfaction on the part of the managers, or so much unemployment among the actors."

This, then, was the position of affairs on the stage in America during the years 1913 and 1914. The commercial men who controlled the theatres there, while admitting that their one object was to make the theatres pay by supplying the public with what it wanted, regardless of the restrictions imposed by dramatic art, were yet not able to carry out the work they considered themselves competent to undertake. Nor were these gentlemen conscious of their own shortcomings, nor did they realise that the system on which the theatres in America are worked was not likely, in the long run, to inspire a sane-minded public or a capable manager with confidence.

Playgoers in America are thus encouraged to believe that the success of a play depends, not upon its intrinsic dramatic qualities or the manner in which it is presented, but upon the mood of the audience at the moment—to like this play to-day and to dislike it to-morrow. But audiences of this sort soon cease to use any judgment at all, so that managers look upon their business as a pure gamble, and put up plays altogether regardless of their merit. "Yet," writes Mr. Denny, as to this disastrous year of 1914, "the big bright spot in the theatrical business was the wonderful success of Sir Johnston Forbes Robertson in his Shakespearean repertory." And it might well be so, considering the extent to which the perversion of the art of the theatre is carried by American managers. The following quotations are taken from Mr. Denny's survey for 1914:—

"At the Comedy 'The Marriage Game' was in its last throes, all attempts to bolster it up having failed." We learn in another paragraph what is meant by the term to "bolster up" a play. "The frigid reception accorded the production of 'Kitty Mackay,' in Syracuse,

had the effect of giving the backers cold feet, so that William Eliott, who had picked it out as a possible winner, had to look elsewhere for financial support, and found it in the direction of his brother-in-law, Morris Gest, who took a three-fourth share in it. The New York papers extolled it highly, and the advance booking then went ahead, the hotels and speculators taking deals, with the result that it ran right through the season. One illustrative incident in connection with this piece is the fact that, after it had gained the approval of New York, a company was sent with it again to Syracuse, where it packed the house during the stay, although the actors were said to be inferior to those who appeared at the first visit." And yet another instance. "'Twin Beds' at the Fulton, a comedy by Salusbury Field and Margaret Mayo, made a rather bad start, which induced the producer, William Harris, to part with his right to the authors. Selwyn and Co. took the matter in hand, with the result that it blossomed into a first-class success. It may be as well to mention that Margaret Mayo is Mrs. Edgar Selwyn, so that the position may be thoroughly understood." Here are other items of interest. "A combination in the playbroking business, which took place at this period, promises still further to add to the manager's trouble. An agitation was begun this month among the stock company managers to reduce the fees for plays, which they claimed were out of all proportion to what was right and just, some of the successful attractions claiming £200 for a week's royalties." "A further attempt to stop the ravages of the ticket speculator was made by the District Attorney, but the effort failed by influence brought to bear by the people interested in the ticket speculation business." "'H.M.S Pinafore' was staged as a solidly built ship, floating in the harbour off Portsmouth, and all the visitors to the ship arrived alongside in boats, and clambered on to the ship by gangways, while the crew manned the rigging just as in real life. The production cost an enormous amount of money, and the attraction proved a failure." "The officials of the Catholic Society for the supervision of plays, issued their first White List. It named 130 plays, of which only eight were produced during the season." At the same time America has this advantage over England, that there are more plays by new authors produced and more theatres have stock companies than over here.

In the *Stage Year Book* for 1914, and also for 1915, the survey of our own drama is written by Mr. E. A. Baughan, the dramatic critic of the *Daily News*. There is very little to choose between the methods of theatrical industry in vogue in America and those in England; but the difference in the criticism of the subject by Mr. Baughan and Mr. Denny is obvious. There is no pose about the American; he makes no effort to apply an academic standard to a class of work which he knows is essentially unacademic; nor does he imagine that those of whom he writes regard their work as anything more than a business, about which they have no secrets and make no mysteries. Mr. Baughan, on the contrary, applies dramatic criticism to what is unworthy of it. As a consequence he fails to point out to his readers that in the majority of cases the English manager is not concerned with the quality of the play he produces, because with him the vital question is how to get a play financed. The capital needed for producing and running a play in London, as in America, does not come out of the pockets of the playgoers as it does on the Continent, where the public pays its money in advance in the form of subscriptions for a whole dramatic season. In London, when the play is financed by speculators for a long run, the risk incurred is considerable, and managers have to invent some way to protect themselves. Fortunately for them, Englishmen are so determined to go to the theatre to see what they like, without in the least knowing what it is that they like, that managers have little difficulty in persuading them that they like what is provided for them. Hence arises the theatre system, a subtle and highly organised machinery, controlled by men who often know more about racing and public-houses than they do about drama. Whatever may be the artistic aspirations of an actor-manager, he has to come under the tyranny of this system, or else to face bankruptcy. An exorbitant rent compels him to make "deals" with box-office agents, bill-posting contractors, and other theatrical agencies, who think less about the quality of a play than of the machinery they can put in motion to manufacture the play into a well-talked-of success. Obviously those who capitalise a play are not content to lose their money simply because the critics and first-nighters call it "rubbish"; and in a few weeks it is paragraphed in all the newspapers in the kingdom that the play is filling the house to its utmost capacity—but filling the house with "paper." It is useless, then, to discuss the drama seriously in this country

so long as plays are financed under the present system. Not until it is possible to get rid of the tyranny of the tradesman and the speculator can any improvement be looked for in our theatres. To the financier the repertory theatre offers no attraction, and Germany knows what it is about when it clings so persistently to its system of subscribers. German writers may, therefore, well write :—

"It is becoming harder and harder for private managers to keep their heads above water. In the big towns, especially in Berlin, they are trying to keep things going by means of the long-run system, with all its bad consequences and its entire dependence on a big 'draw,' or else they do their best to win the coy public by catering entirely for its baser wants. That the only real cure for this lies in the municipalising—at least, to a certain extent—of the theatre, the managers are now beginning to realise, and at the yearly meeting of their society a resolution was passed saying that the Society of German Theatre Directors regards it as one of the noblest duties of German towns to work to a much greater extent than heretofore to promote the interests of the German stage! And all the time the towns, quite apart from the ruling princes, are doing a great deal, and in an ever-increasing degree in that direction, knowing that good theatres are good for them and from a business point of view also, because they attract visitors to the town."

This is a public-spirited utterance on the part of German managers which we may look for in vain from among our own actor-managers.

Then, again, the system which is now prevalent of specialising in the choice of artistes tends to injure the art of the theatre, besides being an indignity to the actor. Some time ago Sir George Alexander pointed out that the modern stage was so terribly overcrowded with even really capable people that actors almost tumbled over one another. But it is only necessary to study the advertisement columns of the theatrical newspapers to understand the cause of this overcrowding. Men and women are chosen by managers, not because they can act a variety of characters, but in order to fill one particular part for which some special physical fitness is required. As a consequence, the capable actor is apt to be ousted from his legitimate work to make room for some one who may be a few inches taller or broader than himself. As an illustration I give some examples of the kind of advertisements which appear in English theatrical papers under the column headed "Wanted, Artistes" :—

Wanted.—Character Actor for Seaman; look twenty-five; slight, about 5 ft. 7 ins.

Wanted.—Character Actor, big build, strong voice, for Policeman.

Wanted.—Responsible Actor, age about thirty, height, 5 ft. 10 ins.

Wanted.—Smart Young Actor, look sixteen, to play Boy Scout; also Tall, Responsible Man for Military Officer.

Wanted.—Pretty, Well-shaped Girl, about seventeen (must look younger), height 5 ft. 2 ins.

Wanted.—A Lady over forty years of age, without wrinkles and with a clear, smooth skin.

Wanted.—Character Actress, for Stout, Nagging Housekeeper, look fifty.

Of course, these advertisements were not inserted by West-End managers, who usually secure their artistes through agents, or by direct communication with the performers themselves. And yet even few of our leading managers realise that versatility is the first qualification for an actor, who should be able to impersonate other people besides himself. At present many men and women are induced to enter a precarious profession in order to undertake a part for which they have a personal resemblance while possessing no ability to impersonate character. At the moment, perhaps, it may seem ungracious to call attention to these matters, but it cannot be doubted that the conditions which determine the employment of actors in this country are apt to injure the well-being of the community as well as the art of the theatre. To-day it is not talent which finds its way on to the stage.

And now, for a moment, let us consider what is the attitude of the literary profession towards Shakespeare, the dramatist, actor, and man of the theatre. Jane Welsh Carlyle remarks in one of her published letters that she has been reading "Love's Labour's Lost," and "found it uncommonly dull." Is the play dull, or was the reader's judgment at fault? There are many reasons why reading to oneself from the printed page is an inefficient test of the merit of a play. In the first place, the drama of Shakespeare is written to be spoken and has special laws of its own. There is, so to speak, a grammar for conversation and a grammar for composition, because in one case it is the ear that must be satisfied and in the other the eye. Moreover, when the language to be spoken is verse, harmony and melody become part of the structure, and it is not until the words receive a suitable delivery that they can be fully appreciated. In fact, dramatic poetry, so long as it remains unspoken, to a great extent may be compared with a composer's libretto — it is something that is incomplete. The music, which in this case is elocution, must be added.

Nor can characterisation be treated in drama as a thing apart from elocution. A teacher of a timid disposition and a hesitating manner, with a voice essentially feminine, will never convince her scholars that the hero of Agincourt is a warrior: at least, not when she is reading aloud his battle speeches to a room full of children. The interest of drama depends also upon movement, of which the printed page often gives no information. Action will give point to words which in themselves may be commonplace. It may then justly be inferred that a play originally written to be acted on the stage is not the same thing when it is published to be read. Shakespeare, Molière, and all practical dramatists uphold this assumption.

On the other hand, there will be a legitimate desire to read a play after it has once been acted. The printed play then becomes, in the fullest sense of the word, a libretto. While the eye scans the words in the playbook, the mind recalls the tones of the actor's voice, the movement of the characters, the stage pictures, and then once more the play lives in the reader's mind. Before Ford, Middleton, or Ben Jonson can be read with pleasure by anyone but the expert or the scholar, their plays need to be revived upon the stage. Thousands of copies of the morality play "Everyman" have been sold since its recent revival; but those who read the play without first seeing it acted fail to realise its merit—it does not interest.

It is often stated that it is more profitable to stop at home and read Shakespeare than to go to the theatre and see him acted. But in so far as this question affects the majority of English readers, it may be safely asserted that Shakespeare is not read at home, and Shakespeare will never be read at home in a general way until he is seen oftener acted on the stage under intelligent conditions. A variety of editions of his plays are published yearly, but excepting for class instruction they are not commonly read. If the books are bought by the general public they are bought for the sake of the binding, or the illustrations, or because some popular actor or editor has written the preface: or it may be that the book is purchased merely as an investment, because it may one day sell for more than has been paid for it. Even the standard plays, other than Shakespeare's, which come out occasionally in neat little volumes, so tempting as an ornament to the bookcase, are either not read or not understood. Seeing on one occasion a dainty volume —it was Webster's tragedy "The Duchess of Malfi"—in a bookcase, I remarked to the owner that the play was shortly to be revived by the Elizabethan Stage Society. The book was then taken down and read, and a severe criticism made upon the waste of time and money involved in reviving "such obsolete rubbish!" When also it became known that the society would produce Ben Jonson's "Alchemist," there was shown much eagerness to obtain the newly published edition of the play, and as a consequence the society's secretary was inundated with letters from members complaining of the intention to revive such a dull and uninteresting play. The "Alchemist," however, proved to be, in representation, one of the most amusing of the society's productions. In the face of experience of this kind it is not surprising if one arrives at the conclusion that to publish unacted plays does little to advance the study of classical drama; it is merely a form of literary commercialism. In fact, their publication does the reverse of the good that is intended. The readers like the binding, the pictures, and the preface, but have no good word to say about the play, and no curiosity is excited to see it acted. The special kind of knowledge and imagination which will enable them to understand the play is wanting. To the reader it is as unlike life as the appearance of a skeleton is unlike the symmetry of the human form.

Besides, not only is Shakespeare little read in this country, but the authorised teaching of Shakespeare in our class rooms tends indirectly to banish the poet, not merely from the stage, but also from the reading-room. Here, again, educational commercialism seems to hamper the promotion of real education. The plays of Shakespeare are not brought before students in a way that will, by the quickest and most direct means, establish an interest in his writings. The method of teaching naturally turns upon the question of what is the most vital part of the play—the drama or the literature, the characters and the incidents or the grammar and the philosophy. Shakespeare's philosophy has for so long been the staple theme of commentators that the importance of the play as a story seems to have been forgotten. But Shakespeare's philosophy is not legitimately open to discussion independently of his characters. The dramatist should not be in evidence at all. The ethical value of Shakespeare's plays as a whole, for good or for evil, may occupy the attention of commentators, but it is enough for the reader to know that Hamlet's theory of

suicide is in flat contradiction to that of Edgar in the play of "King Lear," while both views are consistent with the temperaments of the two men speaking them; which view is Shakespeare's it is not our business to know. Perhaps he was too much occupied in creating the opinions of his many and varied characters to have any left for himself. The practice of using Shakespeare's plays to explain the man Shakespeare leads to endless theories of a profitless kind, and leads, besides, to those errors which arise from detaching dialogue from the context and considering it independently of the characters.

It is the fault of educated opinion in this country that everything belonging to the stage is put down on the side of frivolity; it is never regarded as serious work. An advertisement a few years ago was sent by the Elizabethan Stage Society to a college journal published at one of the leading universities announcing a performance of Marlowe's "Edward II." This play, which had not been acted for over three hundred years, was being revived at a summer meeting at Oxford. Yet the advertisement was refused on the ground that "theatrical notices" were not inserted in a paper devoted exclusively to literature and education. Presumably, had a printed copy of the play been advertised, no protest would have been made. In fact, the poetical drama is of no importance in our educational curriculum beyond giving professors opportunities to lecture on it. Plays are to be treated as literary compositions—"Words, words, words!" That which clothes the skeleton, gives it flesh and blood, makes it vital and interesting, is unworthy of academic consideration. No doubt the modern conditions of the stage are not of a kind to arouse interest amongst scholars. They will tell you that our stage is entirely given over to spectacle or farce, and that it is more profitable to stop at home and read Shakespeare's plays than to go and see them acted at the theatre. But, as previously stated, the answer to this argument is that neither publisher nor lecturer can persuade the man in the street to read his Shakespeare. The value of lectures on drama can be summed up in the question, "What are professors of literature, commentators and editors doing to encourage a taste among the people for poetical drama on the stage, the works of Shakespeare, Marlowe, Ben Jonson, Ford, Massinger, Fletcher, Milton, Goldsmith, and Sheridan?" The answer is: "Next to nothing!" Notwithstanding the achievement of nineteenth-century criticism, the labours of historians and editors of Elizabethan drama, and the progress made in the direction of an intelligent appreciation of the chronology of dramatic literature, to none of our men of letters can we give the credit of creating a demand for acting the poetical drama, in the same way that the late Sir George Grove may be said to have made classical music popular. And Sir George Grove was not a musical conductor, nor an impresario, nor even technically a musician; he was a musical critic who, instead of lecturing about Mozart and Beethoven, determined to get the forgotten works of these masters performed. It must be admitted, then, that the main cause of this stagnation in things connected with the higher interests of the stage is to be found in the want of sympathy which exponents of literature show for acted drama. The most pressing need of the moment is to found at our universities a chair of Histrionic Art, so that the talkers on drama may have some knowledge of what they talk about; that they may grasp the fact that there is a distinct art of the drama, with its own principles and its own technique; that they may inculcate respect for this art, and give themselves the opportunity of trying their hands at its form of composition; that they may realise, in fact, what are its real difficulties. Something practical can surely be done to get justice done to Shakespeare's intentions upon the modern stage. If professors of literature made it their business to attend all Shakespearean performances and to criticise them publicly instead of merely ignoring them, managers would then realise that they had something else to reckon with than a theatre full of amusement seekers. Above all things, the man of letters should recognise that if the poetical drama needs for its interpretation on the stage a special school of training for its actors, then scholars and actors must combine to create it; for the one cannot do it without the help of the other. Meanwhile something practical can be done towards securing a larger proportion of intelligent playgoers. Dramatic literature should be studied under more stimulating conditions than it is at present; that is to say, every college should have its "two trestles and a board" from which the poetical drama can be declaimed, and by reviving the art of elocution give to both poetry and drama new life.

But it is contended that Shakespeare is one of the world's three greatest men, and that he is venerated by a large section of the public who

never enter a theatre. From this it is to be inferred that a certain, and by far the largest, section of the British public either objects to Shakespeare's plays being acted on the stage or dislikes seeing them acted there. This, I hold, is an indefensible attitude for the admirers of Shakespeare to assume. It is as unreasonable an argument as it would be to contend that those who wear boots are not indebted to bootmakers. Shakespeare learnt his art in the theatre, and most of his plays are built upon the foundation of older ones. It is inartistic to criticise his poetry apart from his plays. The injury done to his drama by such treatment is expressed with admirable insight in a letter I received from the accomplished actress, Miss Constance Collier, and which is here read with her permission :—

"I am absolutely in sympathy with what you say. Shakespeare was an actor, and wrote his plays for actors, to be acted in the theatre. It is entirely through the academic attitude of the gentlemen who expound him to us from the study that the deadening, bent-knee attitude towards Shakespeare in the public mind has arisen. It is an uncomfortable position to be on one's knees perpetually; that is why audiences keep away, and shirk the support of Shakespeare.

"Whenever he is produced in the theatre by a man who understands the theatre, the audience love him, and are surprised by him anew—his gaiety, his humanity, his optimism, his humour. The only thing one has to get over in the audience is the deadening reverence that has been taught them by the literary mind towards Shakespeare in their youth. They have been taught him in their schools by the undramatic mind. Poor Shakespeare has been analysed and pulled to pieces and dissected and put together again, and all that they realise of his beauty and charm and dramatic power is intense stodginess.

"It is absolutely essential that the drama and dramatic plays should be taught by dramatic teachers. It is better to send a sailor up a mast than a tailor.

"There is a certain air of patronage towards the theatre in England to-day, particularly among literary people. It is curious and very funny, when one remembers that both Shakespeare and Molière were actors. The Shakespeare celebrations should certainly be in honour of our profession and our profession should be at the head of them."

After all, is it not an incongruous procedure to wrest the dramatic poet from his proper environment, the stage—a place which has been appropriately named a mirror, because it professes to reflect life in all its aspects without favour or prejudice? There is only one Shakespeare to whom Englishmen can pay homage in 1916, without at the same time showing disrespect to his memory, and that is to Shakespeare, "the supreme dramatic artist." In Germany he is so acknowledged, and why not also in his own country? Professor Brandle, speaking before the members of the British Academy in London two years ago, said :—

"The blessings of a repertory theatre, and the best portions of modern German literature, we owe principally to Shakespeare. He has given us the plays which at the outset drew the largest audiences, trained the best actors and critics, and which were taken as models by the more gifted playwrights. The theatre is the stronghold of the Shakespeare cult in Germany."

And George Brandes, when lecturing in this country, said: "It is forgotten, here, that Shakespeare wrote plays to be acted." Surely this forgetfulness is in a great measure due to the persistent way in which our educationalists ignore the stage on every occasion when reference is made to the dramatist, either in print or in the class-room.

Perhaps it has hardly yet dawned upon the dramatic profession, as a whole, what is its opportunity in 1916, and what it stands to lose by neglecting to take a step forward, and to shake off the influence which has so persistently overshadowed the genius of the English stage, and refused it the right to be guardian of Shakespeare's reputation. If it is the business and duty of the literary profession to make itself responsible to the country for the interpretation and appreciation of the poet's plays, then the dramatic profession has no status, and our theatre is merely a theatrical industry. But Shakespeare is not only the foundation-stone of the modern theatre, he is also the keystone of it, for his supremacy in the theatre is admitted in every country but his own. And whatever shortcomings in the representation of the dramatist's plays may be brought against the English theatre, they are chiefly due to those educationalists who forget that it is both the business and the duty of the stage to treat Shakespeare's plays with respect and intelligence, whenever and wherever they are acted. But it is scarcely reassuring to find the meeting on July 3rd, 1914, at the British Academy, thus reported in a prominent London daily paper :—

"The matter of the speeches, no less than the distinction of the orators, rose to the occasion yesterday at the Royal Society's meeting in connection with the approaching Shakespeare Tercentenary. Evidently something worthy is going to be done in 1916. With two or three honourable exceptions, our theatrical managers may leave

Shakespeare alone, but the people read him more and more, and he grows ever increasingly a part of the national life and spirit."

Perhaps no more inaccurate statement ever got into print—at least, not in my own experience. It is true that there is an immense amount of writing and talking about Shakespeare now going on, but not 2 per cent. of it has any connection with his plays; nor have I any recollection of coming into contact with a single individual who reads Shakespeare except for professional, or under compulsory, reasons.

Let me conclude by asking those present to take away with them, for the sake of remembrance, the following five sentences, as summing up what is vital in my address:—

1. *The theatrical industry as it exists in England to-day.*—I ask you to connect with this sentence the words of Sir Philip Sidney: "What is birth to a man if it shall be a stain to his dead ancestor to have left such an offspring?"

2. *The present status of the actor.*—Let us add to this sentence the words of Hazlitt: "Players are not as respectable as a profession as they might be only because the profession is not respected as it ought to be."

3. *The attitude of Shakespeare towards the learned professions in his own country.*—Clifford Harrison's words may here, I think, appropriately be quoted: "I have an almost measureless admiration for scholasticism, but I have also a bitter envy of it, and an inborn antagonism to it."

4. *The real Shakespeare.*—"Soul of the age, the applause, delight, the wonder of our Stage." These are the words of Shakespeare's most intimate friend and contemporary, Ben Jonson.

5. *Conclusion.*—That in the coming Shakespeare Tercentenary Celebrations, it is vital to the best interests of the stage that Shakespeare's name shall be immediately connected with the modern English theatre of which he himself, actor and part theatre manager, as well as dramatic poets is the founder, inspirer and highest ornament.

DISCUSSION.

MR. BERNARD SHAW said the occasion was a very interesting one to himself, because it had brought together in public the Chairman and the author of the paper. Despite the fact that their connection with his (the speaker's) own profession —that of the theatre—was so very conspicuous, this was probably their first meeting. In any period in which art was active there were two orbits which never crossed one another. One was the orbit of the man who dealt with an established form of art and carried it to its highest consummation and perfection — always, he might say, a contemporary form of art— always working with actually living persons in an art which belonged to their own period. The other was the orbit of the man who, finding the established forms of the art altogether repugnant and impossible to him, and believing them to be entirely wrong from beginning to end, immediately started on a forlorn hope and tried to turn the public taste upside down. In the present day the first orbit was that of Sir Squire Bancroft, and the second orbit was that of Mr. William Poel, who had made the very great mistake that day of not talking a great deal more about himself and about his own career. When he (the speaker) first came to London he saw with great delight and pleasure the theatrical art as presented by Sir Squire Bancroft at a pitch of perfection from which it had never descended. Afterwards Mr. and Mrs. Kendal and Sir John Hare carried on the traditions very excellently and beautifully, but Sir Squire Bancroft had reached a summit in art beyond which there was no progress. Sir Squire Bancroft had worked hand in hand with his author, Robertson, who wrote his plays for the sort of stage that Sir Squire handled so well. Some people used to say that this stage was a stage of illusion—a thing which he (the speaker) altogether demurred to. In a drama written by Robertson and handled by Sir Squire Bancroft there was no illusion on the stage at all; what was seen was the actual thing. A room was seen on the stage; the actual walls were seen. It was true they were not made of brick and mortar, but only of canvas; but if the audience looked at the walls of the room they were at present in they would not see the brick and mortar, but only the applied paint or paper, and that applied paint or paper was what they saw on the stage. When he produced a play, he had to select the wallpaper exactly as if it were for a real house, except that he chose it with reference to the taste of the persons in the play and not according to his own. People said that rooms on the stage were not real because they had only three walls. He would give a five-pound note to any member of the audience who could see at the same time the four walls of the room in which they were at present. As he had said, there was no question of illusion in the matter. There was the real thing. Most modern plays, including his own, were written for that particular kind of production. The art of that production, as practised by Sir Squire Bancroft, working hand in hand with his author, Robertson, had reached a point that had never been surpassed. When it came to dealing with Shakespeare it was a different thing. When he (the speaker) first saw Shakespeare on the London stage, never for one moment was Shakespeare really there at all. There was no illusion. The more they tried to produce illusion by scenery the less illusion there really was. Performances could be made interesting by an individual actor of extraordinary power and attraction, but it was always the actor who had to do it. He had seen Shakespeare acted with scenic arrangements which would be inconceivable

to the younger members of the audience who were present that afternoon. He was quite familiar in his youth with the changing of scenes and the pushing on and off of flats in full view of the audience. But even if an actor of extraordinary power and attraction was there, the audience did not get Shakespeare, as, with all the shifting and changing of scenery and the thing being arranged in the way in which it was, about one-third of the play was cut out. Now that was where Mr. Poel came in. He was the man who really did understand that that kind of Shakespeare, except as a sort of springboard for an individual actor of extraordinary talent, was unendurable; and with very inadequate resources he had gradually got at the people who really loved Shakespeare, and given them Shakespeare's plays as Shakespeare intended them to be played. There were very few Shakespeare lovers. He (the speaker) was very happy to say that he was one, and another was Mr. Granville Barker, who was at the present time giving performances of Shakespeare in New York with great success, just as he had given them in London, from one end to the other, without one line being left out. And Mr. Granville Barker began as one of Mr. Poel's Elizabethan stage players, and was always proud to acknowledge his debt to Mr. Poel. He (the speaker) would end as he began. The two orbits had never crossed. As far as he knew, the Chairman and Mr. Poel had never met before; and that was a fact which made the occasion an extraordinarily interesting one. Personally, he felt a very great regard for both gentlemen, and professionally the deepest gratitude to them; and if anything in the nature of a vote of thanks were to be moved, it would be impossible for him to discriminate between the two, as they had done superb work for the theatre in their own particular ways.

A vote of thanks to the author for his interesting paper was then put, and carried with acclamation, for which Mr. Poel briefly returned thanks.

THE CHAIRMAN (Sir Squire Bancroft) said he rather regretted the paper had had to be read on a Wednesday afternoon, as it deprived those members of his profession who were now more prominently before the public than he himself was of the opportunity of being present and making any remarks on the paper. He hoped Mr. Poel would forgive him if he said, in all friendliness, that he was a little "fed up" with Germany. He admitted frankly that he was not in the mood to consider or reflect upon the culture of that nation until our heel had trodden upon her militarism. When that was done, once and for all, he would be better able to listen to all the greatness which belonged to her. He desired to thank Mr. Bernard Shaw for his kind remarks, although most of them should have referred to his wife and not to himself. It was she who discovered Mr. Robertson, and in illustrating him he was only too proud to have the privilege and the honour of working by both their sides. With regard to the immortal name of our greatest poet, he could only say that he should for ever feel proud to think that he had been what William Shakespeare was—an actor.

CANADIAN INDEBTEDNESS.*

In the course of the past summer I visited Canada, partly with a view to investigating upon the spot the opportunities which the Dominion might afford for mortgage investments, and partly in order to gain, at first hand, knowledge of the general financial conditions of the country.

In the course of my tour I travelled right across Canada from Quebec on the East to Vancouver City and Victoria on the West, visiting the principal towns of the various districts, interviewing bankers and leading citizens everywhere, and endeavouring to master the intricacies of the legal procedure involved in carrying out mortgage transactions in Canada.

It is difficult to convey any adequate idea of the vast size of the Dominion, or of the great distances which separate the chief towns from one another. But Quebec is as far from Vancouver as from London, and the journey by the quickest train takes five full days of continuous travel.

It should be borne in mind that my visit was made at a time when many circumstances combined to render the financial position of Canada extremely unsatisfactory. The gradually increasing land boom and real estate speculation, which culminated in 1912, were followed by a great collapse, the effect of which soon showed itself upon all the business interests of the Dominion. In particular, the absence of dealings in real estate caused a cessation of building operations in the prairie provinces, and this in its turn led to severe depression in the lumber trade of the West, so that wide-spread unemployment immediately followed.

In an extremely interesting speech dealing with the conditions in Canada a few months before the outbreak of war, the Hon. Sidney Peel, President of the Trust and Loan Company of Canada, said:—

"The collapse of this land boom has had the usual effects. Many people find themselves landed with real estate at prices which they can never recover and with instalments to pay which they undertook with a light heart in the hope of being able to pass their purchase on to someone even

* Abstract of a paper on "Canadian Mortgages regarded as a Field for the Investment of the Funds of British Life Assurance Companies, with some General Notes on Canadian Indebtedness," read before the Institute of Actuaries by Arthur Digby Besant, B.A., F.I.A., General Manager and Actuary, Clerical, Medical and General Life Assurance Society, on December 21st, 1914.

more speculative than themselves . . . . . The collapse of a boom brings difficulties, but times of stringency are, as I have pointed out before now, by no means unfavourable to mortgage companies. They can choose their investments and make them at good rates and on reduced valuations."

At the beginning of the summer it was thought that the worst stage had passed and that improvement was setting in; but all hope of this was destroyed by the war, and since then the depression has gradually increased. Under the circumstances it is inevitable that this paper must present a somewhat gloomy picture of the conditions existing to-day.

Canadian Indebtedness.

The growth of Canadian indebtedness during recent years has aroused much interest, mingled with some anxiety, and a few general notes on the subject may therefore not be inopportune.

It is far from easy to ascertain the full extent of Canadian borrowings, for, apart from the large loans which have been floated on the London market, amounting now to five hundred and fifteen millions sterling, it is estimated by Sir George Paish that upwards of one hundred millions sterling of American capital has been invested in the country, and that not far short of another one hundred millions has been lent, much of it privately, on mortgages of real estate and by way of loans to farmers. The total amount of foreign capital supplied to Canada thus amounted at the end of the year 1913 to nearly seven hundred millions sterling, carrying with it an interest burden of about thirty-two millions sterling per annum. It is startling to find that one-half of this great sum has been lent within the past seven years. Reckoning dollars at five to the £, these loans may, roughly speaking, be analysed as follows:—

(*a*) Dominion Government (net)	£70,000,000
(*b*) Provincial Governments . .	26,000,000
(*c*) Municipalities . . . (say)	70,000,000
(*d*) Railways	300,000,000
(*e*) Industrial companies and real estate mortgages . . (say)	234,000,000
Total . . .	£700,000,000

It is not, however, sufficient to regard merely the amount of the debt; we must also take into account the assets which it represents, and endeavour to trace whether the heavy borrowings necessitated by the growth and development of a new country have been justified. That there has been extravagance in some quarters is undoubted; and certain industrial and other loans which have involved the lenders in heavy loss have been open to severe criticism.

But taking a broad view, there can, I think, be no question that the bulk of the immense amount of capital poured into Canada in recent years has been wisely expended. Much of the borrowings by the Dominion Government has been spent upon remunerative enterprise and public works represented by tangible assets. This applies also to the greater part of the debt incurred by the Provinces. The portion of the Dominion and Provincial Government expenditure most open to criticism is that made in respect of certain railways where there seems little prospect of an adequate return on the capital expended. There will be much more divergence of opinion in this country as to the wisdom of much of the municipal expenditure.

A notable feature of the past few years has been the increased attention which British capitalists have devoted to industrial development in the Dominion. Large sums have also been lent to farmers in the prairie provinces, and this expenditure should prove remunerative to the lenders as well as advantageous to Canada.

Dominion Debt.

From the figures presented by the Hon. W. T. White, the Minister of Finance, it would appear that the Dominion debt has shown very little growth during the past few years, and that against the one hundred millions of liabilities there is a set-off of over thirty millions of assets consisting of Sinking Fund, Specie Reserve and miscellaneous investments, so that the net debt is really under seventy millons sterling.

Most of this debt has been incurred for developing and opening up the country, and in view of the enormous size of the Dominion its amount may certainly be considered at the present time as not only legitimate, but moderate, seeing that the Dominion Government supplies large subsidies for capital outlays upon the larger public works and national undertakings.

As the Dominion Government does not levy direct taxation, but obtains nearly the whole of its revenue from customs and excise, the falling off in imports arising from the outbreak of hostilities will cause a serious loss of income, while concurrently the expenditure for war purposes will be very heavy. It seems inevitable, therefore, that even if some of the expenditure on new public works can be postponed, the near future must show a large increase in the Dominion debt.

Provincial Debt.

The Provinces in Canada are independent countries so far as their internal government is concerned.

They, like the Dominion, practically levy no direct taxation, and their chief sources of revenue are the Dominion subsidy, the proceeds of the sales of land, timber and mining royalties, succession duties, fees and licenses. The chief items of expenditure are public works (roads, bridges and ferries), legislation, administration of justice, provision of hospitals and asylums, and large subsidies for education. In most of the Provinces expenditure slightly exceeds income.

The total provincial funded debt in December, 1913, was twenty-six millions sterling, of which eighteen millions had been raised in London. Two

years previously the London debt was fourteen millions, and in 1902 under ten millions. The increase in the indebtedness is spread over the whole country, though it is most marked in the newer Provinces of the West. The eight millions raised outside London have gone chiefly to the Provinces of Ontario and Alberta.

In addition to these direct obligations, the Provinces have guaranteed the principal and interest of thirty-six millions of railway securities, chiefly to facilitate the construction of branch lines of the Canadian Northern and Grand Trunk Pacific.

The Provinces have expended money lavishly in the erection of palatial parliamentary buildings, and the public offices generally are built on an extravagant scale. The rivalry between the Provinces and the universal love of display have undoubtedly led to extravagance in many directions.

Municipal Debt.

The municipal indebtedness of Canada, according to Messrs. Wood, Gundy and Co.'s statistics, had in December, 1913, reached the total of over 102 millions sterling. Twelve millions of this is termed "Local Improvement" debt and is charged primarily upon the owners of the property benefited by the expenditure, though, of course, in the last resort the municipality would be liable. Of the 102 millions, only 40 millions have been publicly raised in the London market, and I think that it will come as an unpleasant surprise to investors in this country to find that this huge additional liability exists.

The total of the London loans two years previously, *i.e.*, at the end of 1911, was 22½ millions, while in 1906 and in 1901 it was under nine millions. It is very significant to notice that during the five years 1902–1906 inclusive, the amount of the indebtedness was virtually stationary so far as the London market was concerned. The explanation seems to be that such loans as were required in that period were absorbed by Canada herself. The era of expansion of municipal borrowing in London began about 1907 and, as will be observed, developed with extraordinary rapidity during the years 1912 and 1913.

The 36 millions which have been raised by these cities either publicly or privately outside London were issued chiefly in Canada or in the United States, and while the latter country is a large permanent holder of these bonds, there is no doubt that a considerable proportion of the remainder ultimately found purchasers in England.

The remainder of Canada's municipal debt, amounting to about 26 millions, is spread over 838 cities, towns and villages, embracing practically every place with a population of 1,000 and upwards.

In addition to the funded debt there are outstanding City Treasury Bills amounting to just under two million pounds.

Much of this expenditure of a hundred millions has been incurred for remunerative enterprises, for, whether rightly or wrongly, municipal ownership of all "Public Utilities" is regarded, especially in the West, as being advantageous to the community. Many new towns have, therefore, been provided with municipal water, electric light, electric tram-cars, telephones, etc., indeed, with all the comforts enjoyed by cities of much older foundation. Up to a certain point this policy may be justified, but in many instances it has been carried far beyond the limits of prudence.

The municipalities impose direct taxation by means of what is known as the Corporation Tax, and out of this all payments for police, sewage, lighting, improvements and general administrative expenses are met. This tax is based upon the assessed capital value of all land and buildings within the areas under the municipal control. A special tax, based upon the same principle, is levied for education. Generally speaking, Canadian municipalities are allowed to borrow up to something like 20 per cent. of the assessed capital value. It will thus be seen that the temptation to raise the assessed value in order to increase their borrowing powers is very great.

I found that there was a consensus of Canadian opinion that in the last few years money has been lent far too freely by England, and on far too cheap terms, especially to the small new cities.

The rapid growth of Canadian municipal indebtedness during recent years has excited a good deal of uneasiness in this country, and many months before the outbreak of war the terms on which such loans were taken up by the London market had grown so onerous that a slackening in the stream of new issues had become inevitable. The war, coming without any warning, has suddenly caused a complete stoppage in the importation of money, and the effect upon the municipalities has been immediate and severe. They were caught unprepared, and works of "Public Utilities" of every description are either suspended or are being completed by means of short-dated loans at ruinously high rates of interest. Unemployment in the towns is already so rife that every effort is being made by the municipalities to continue whatever work is in progress, but there can be no doubt that some of the more heavily indebted towns have an anxious winter before them. Municipal income is now falling off owing to difficulty in collecting the taxes, and for the first time expenditure has to be paid for out of income, since fresh loans are no longer available. So far there has been no default; but the full effect upon Canadian municipal finance of the absence of new loans has yet to be seen.

Canadian Railways.

The latest official figures published deal with the railway statistics for the year ending June 30th, 1913. At that date the mileage operated was over 29,000, and a further 18,600 was either projected or under construction.

The capital liabilities of the Canadian railways amounted to three hundred and ten millions sterling, made up as follows :—

Funded debt (bonds, &c.) . .	£125,000,000
Debenture stock (C.P.R.). . .	33,000,000
Stocks	152,000,000
Total . . .	£310,000,000

Of the above, the bonds and stocks outstanding on account of lines under construction amounted to £36,000,000, so that the capital account of operating railways was £274,000,000.

The average rate of interest paid on the funded debt was just over 4 per cent., and it is satisfactory to note the official statement that the full interest was paid on all outstanding bonds.

In considering the prospects of the railways throughout Canada the question of the harvest in the Prairie Provinces is a factor of the utmost importance. It must be remembered that, great as is the output of wheat at the present time, the area of cultivated land does not represent more than a fraction of that suited for the production of wheat, and there can be little doubt that, as the population increases and a larger area comes under cultivation, there must be a great corresponding development of the railway system. The construction of branch lines in every direction will need much further capital in the future. Possibly at the outset these lines may not be remunerative, but they will lead to the more rapid development of the districts through which they pass, and ultimately should justify the capital expended on them.

The opening of the Panama Canal obviously cannot fail to affect the Canadian railway system, but it is yet far too early to hazard an opinion as to whether the changes will be favourable or adverse. From different quarters I heard the most diverse views on this subject. It appears to be generally agreed, however, that so far as British Columbia is concerned the opening of the Canal will be advantageous and will lead to a great development of the fishing, fruit and mineral industries, and that the railways operating in those districts should be helped thereby.

Industrial Companies.

While England has taken the chief share in financing the railroads and in purchasing Government and municipal securities, the capital provided by the United States has been more largely employed in promoting industrial enterprise. This is perfectly natural, for their means of obtaining local information as to industrial opportunities have, of course, been far more numerous than those open to English investors

The magnitude, however, of the monetary interests involved is very large, for upwards of sixty to seventy millions of American capital, seventy millions of British, and ten millions of European capital have been lent for the development of hydro-electric works, coal mines, iron and steel industries, lumber, pulp and paper industries, fisheries, milling industries, various lines of manufacture and other more or less local and domestic enterprises.

Real Estate Mortgages.

Canadian loans on landed property fall into three main groups, secured respectively upon (*a*) central city property, (*b*) residential city property, and (*c*) farm lands.

Loans on central city property are similar to many of our home mortgages, and thus instinctively appeal to us more than the other types. Under the fairly settled permanent conditions which are found in a relatively old city like Montreal these loans are undoubtedly good, but in the West I regard them as being speculative in the extreme, for valuations made up to a year or two ago have been based upon an inflated standard which has to-day utterly collapsed and has not yet reached any new level of stability. The yield is 6 per cent. and upwards under normal conditions.

Loans on residential city property are regarded by many Canadian authorities as affording security of the highest class, and in the wealthy suburbs of the more important Canadian cities, where the population has hitherto been rapidly increasing, and where the demand for such houses has so far been greater than the supply, it seems reasonable to regard such residential property as likely to continue to appreciate steadily in value, and thus to form a satisfactory field for investment. The rate of interest yielded on this type of security varies from 6 per cent. to 7 per cent. under normal conditions at Montreal, and is a little higher at Winnipeg and Vancouver.

Loans secured on farm lands are largely granted in the Prairie Provinces, and although very foreign to our preconceived ideas at home, have much to recommend them.

The chief advantage of this type of security is that there is not the same danger of inflated values as is met with in town plots, and further, that as the loan is used to improve the land, the security for the mortgage is thereby automatically increased.

Local knowledge is essential for success in granting loans of this character, and the only way in which such business can be safely conducted is to place entire confidence in a responsible local agent and to act implicitly on his advice. Allowing for agent's commission, the yield on loans of this character would be about 6 per cent. for the first year and 7 per cent. thereafter.

Modes of Investment.

In the United Kingdom loans on landed property are usually granted by way of a direct mortgage, but there are a great many difficulties in adopting this method in Canada. These arise from the fact that the systems of land tenure differ widely in the various provinces, and in many cases the formalities can hardly be complied with unless the lender is on the spot. It has thus come about that

private lenders prefer to carry out such loans through the medium of a Trust Company.

These companies fulfil a very special function in Canada, seeing that the banks are not allowed to make advances upon land. The banks get over the difficulty by forming a subsidiary trust company. Thus the Royal Trust Company is to all intents and purposes the Bank of Montreal. A trust company merely acts as an agent for its clients. It undertakes the investment of money, investigates titles, arranges valuations and carries through all the preliminaries. It does not undertake liability for the loans in any way; it merely uses its machinery in the interests of its clients and does its best for them. It is remunerated by a commission on the loan, and by an annual payment for collection of interest and for general supervision.

Undoubtedly the machinery of such a company as the Royal Trust is at least as effective as that of any local board—probably much more effective. The disadvantage of the system is that the mortgages must all be granted in the name of the Trust Company. In fact, the name of the lender would not appear publicly at all, and it will thus be seen how entirely he would depend upon the good faith of the Trust Company.

In conducting mortgage business in Canada the essential points to be borne in mind are –(1) The danger of inflated valuations, especially in the Western cities; and (2) the need of adequate local supervision. For the moment the second point is the more important, for in the present depression of the real estate market values fixed a few years ago are crumbling and will continue to fall until they reach a natural level.

I regard the appointment of a local board or of a representative in whose judgment complete reliance can be placed, and must be placed, as the only means by which mortgages of a safe and high-class character can be secured in the Canadian cities. And this, in my judgment, is a permanent condition, for, as I was so often reminded during my tour, you cannot exercise much supervision in selecting the right or in avoiding the wrong mortgages if you are 3,000 or 5,000 miles away.

SUMMARY.

I will close this paper with some general observations on the Canadian financial outlook. For much information set out in the notes which follow I am indebted to Sir Frederick Williams-Taylor, the General Manager of the Bank of Montreal.

(1) Canada is at present passing through a very adverse time, and the present winter will be a period of grave anxiety.

(2) So far the Eastern cities are standing the strain much better than those of the Middle and the West, partly because of their manufacturing industries and partly because they have had time to accumulate some reserve of wealth.

(3) In spite of the development of the farming industry in the Prairie Provinces, the population in the cities has been increasing much more rapidly than in the country. It is hoped that the present depression will force men on to the land, so that they may become producers instead of merely distributors of wealth.

(4) The total amount of English capital publicly invested in Canada amounted, in December, 1913, to over five hundred millions sterling, many millions of which have been wasted in municipal and industrial enterprises.

(5) In 1913 English capital poured into the country at the rate of six millions sterling a month. This has suddenly stopped, and few Canadians recognise how enormously the industries of the country have depended upon this constant influx of new capital.

(6) The indebtedness of Canada to England involves a monthly payment for interest of two millions sterling.

(7) The payments for war expenses have now to be met in addition. Every gift of Canada to the Empire will have to be met ultimately by a loan in London.

(8) Canada will now go through a time of severe trial in attempting to meet expenditure out of income instead of out of loan, and the intensity of the strain will increase with every day's duration of the war.

(9) It has already been found necessary to adopt a moratorium in the Prairie Provinces to suspend the due payment of interest and instalments of purchase money on land loans, and even in the East there is a strong agitation in favour of some similar legislation for the relief of distressed borrowers.

(10) "Unfortunately economy is not a popular text in a country that has been borrowing so freely for so long."—(The *Economist*, October 24th, 1914.)

These are the adverse facts, and it is well to face them. But I want you to bear in mind that these difficulties are temporary and will pass away. The natural wealth of Canada is enormous, and she will emerge a healthier, stronger, and more self-reliant nation. The greatest asset of Canada is her annual harvest, and, in comparison with the value of this, municipal extravagance can hardly be said to be of fundamental importance. The harvest this season is inferior in quantity to that of last year, but prices are so much higher on account of the war that the farmer is prospering.

Moreover, in considering the future, it must be remembered that so far mineral and even agricultural development is in its infancy. But the spirit of confidence in the future of the country is universal, and shrewd observers welcome the check to speculation which the present set-back has caused and the impetus it has given to the movement for forcing men on to the land.

In summing up impressions of Canada we have to remember, as Sir F. Williams-Taylor reminded me, that we are dealing with a vast country and that we must avoid thinking parochially. There have been periods of depression before and they

have passed. In the same way every Canadian believes that this one will pass in its turn, and that a new era of development and prosperity lies ahead.

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ENGLAND AND THE PERSIAN GULF.

The return of the Indian Viceroy to India from the Persian Gulf and his decoration of the chiefs who have shown their loyalty and good service in the recent operations in those regions, coupled with his carefully weighed address to the deputation at Busrah, seem to leave no room for doubt as to the pending annexation of that notable port and province. Lord Hardinge is not the first Governor-General who has been quick to mark his appreciation of the political importance to India of the island and small States dotted about the Gulf. Over a hundred years ago Warren Hastings laid down his firm conviction that these regions were intimately related with Hindostan, and their mastery was a matter of great consideration to the predominant Power in the East. In fact, Warren Hastings's statement of policy differed but slightly from that laid down by us a few years ago, and the recent visit of the Viceroy has cemented our ties with our Persian and Arabian outposts of Empire. At the south-eastern extremity of the Gulf we have Muscat, which, though not actually British territory, is now more completely within our control and restricted from scattering broadcast its former exports of guns and ammunition. Northwards along the Arabian coast we have the Bahrein Islands, over whose trade we keep watch and act as maritime police, while still further to the north-west lies Koweit, the small independent State

under our protectorate, whose harbour is the best in the Gulf. On several occasions the Turks have tried to lay claim to authority over this district, but these pretensions we have always firmly repudiated, and now that the Sheikh has been created a K.C.S.I. by Lord Hardinge the State is still more firmly linked to our cause. Proceeding up the Shatt-ul-Arab, we eventually arrive at Basra, which, with Kurnah, is in our own actual possession and marks our headship of authority, whence proclamations and orders will now issue. It is interesting to recall that Basra actually belonged to the East India Company as far back as the eighteenth century, and its reversion to its former masters is a significant movement of the times. On the Persian side the more important signs of British settlements in evidence are Mohammerah and the Anglo-Persian oil works, while further south are Bushire, Lingah, and, finally, Bunder Abbas at the extreme south. All these ports mark points which will need linking up by improved communications. In connection with these events one must note with regret the death of Captain W. H. J. Shakespeare, C.I.E., late Resident at Koweit, who was killed in action on January 24th, and whose distinguished service in the Indian Political Department and useful services in this region, together with his recent expedition and travels throughout Arabia, have attracted much attention. Lastly, we can scarcely avoid noticing the interesting anticipations formed in some of the Indian journals, who are naturally following the course of events with keen attention, that the future of Mesopotamia concerns the Government of India in more ways than one. The restoration of the irrigation works, designed by Sir William Willcocks under the Turkish authority, calls urgently for completion under its new mastership, while the scanty population of Mesopotamia, once the granary of the East, would supply room for many millions of Indian emigrants, for whom there is no possibility of large new irrigation works.

THE ESPARTO INDUSTRY IN SPAIN.

Among the more important industries of the Province of Almeria, and one upon which thousands of its inhabitants depend for livelihood, is the gathering and manufacture of esparto, a coarse grass with a round flexible stem, which, under favourable conditions, grows to a height of three feet, but whose general average height ranges from twelve to eighteen inches. Although it is an extremely hardy plant and capable of making a thrifty growth even on the arid mountain sides of the interior of the province, yet the esparto grown in regions where the rainfall is more abundant develops to a much greater height. It is found in varying quantities on most of the uncultivated land. Esparto grows in isolated clusters, and, unlike ordinary grass, it does not cover the ground with a mat of roots. The esparto on the lowlands near the sea develops earlier in the season, and grows larger than the product found in the mountainous regions of the interior.

The harvesting of esparto begins in May, according to the American Consular Agent in Almeria, and continues until December. The plant is perennial, and grows during the summer months and in the spring. In gathering, the workman holds in one hand a short stick; by a twist of the hand and wrist he wraps the grass round the stick once or twice, then gives a quick upward pull, separating the stems at the joints near the surface of the soil. It happens sometimes that if the workman is not careful the grass is pulled up by the roots, which not only injures the future crop, but lowers the quality of the esparto, as it is necessary to eliminate the roots and adhering partly decayed grass, the paper manufacturers not being able to use these portions. The esparto lands belong in part to the municipal government, and in part to private individuals. As a general rule the lands are awarded for exploitation to the highest bidders for a fixed period of years; these tenants exploit the leased property on their own account, employing workmen to pull the grass at harvest time. These workmen receive from ninepence to one shilling for gathering a quintal (100 lbs.) of esparto, and are able to earn from two shillings to two shillings and sixpence a day, depending upon the size of the grass, the proximity of the bunches, the dexterity of the workman, and other factors.

Once the grass has been pulled it is tied into straight bundles or sheaves containing several pounds each. The esparto is then conveyed to the nearest factory. There are at present in the city of Almeria three important esparto factories, employing from one hundred to two hundred persons each: in these factories the esparto is cleaned, assorted, classified, and baled, preparatory to shipment to the paper manufacturers in the British Isles. There are also a number of smaller factories engaged in making esparto ropes, baskets, rugs, carpets, saddles, saddle-bags, and numerous other articles used in households and in the industries; these articles of esparto can be constructed at very low cost, and possess remarkable qualities of durability and flexibility. The value of the domestic esparto delivered at the factory at Almeria ranges from two shillings and sixpence to three shillings and fourpence per quintal (100 lbs.). Nearly all the work of assorting and cleaning the esparto in the factories is done by girls and women, who usually work in couples, one picking out the heckle (esparto wild roots), and the other separating the bright new stems from the old and those unfit for paper-making on account of the absence of cellulose.

The work is done on long wooden tables, each girl being assigned to her own place and her own operation, and with her partner working on her own account by the piece. An experienced girl with close application may earn from one shilling

and eightpence to two shillings a day; but the work is very trying to the eyes. The bright new stems are known as "Class No. 1," and the inferior as "Class No. 2." After the grass has been selected and classified it is tied into bundles, and is then ready for final inspection, after which it goes to the baler. Grass with roots is sent to the "heckling" department, where the roots are removed by striking them on a fixed iron comb standing upright on a frame. The roots, with other waste materials, are used as bedding for live stock. Class No. 2, composed principally of old dry grass, is unfit for paper-making, and is therefore thrown aside and used for basket and rope-making. The baling apparatus consists of a heavy horizontal press, cubical in shape, and measuring somewhat over four feet each way. The small sheaves are placed in their proper position in this press and trampled down by a man, and a heavy iron weight is screwed down. The cords used for binding the bales consist of esparto ropes, which are securely fastened by hand while the bale is being compressed. This operation completed, the bale is removed from the press, weighed, registered, and sent to the storage department. A bale on an average weighs 385 lbs. It is claimed that most of the eye diseases, and cases of partial and total blindness, which are prevalent in the city and the province of Almeria, are caused by the poisonous dust coming from the esparto as it is being handled in the field and factory.

VINTAGE IN ITALY, 1914.

Notwithstanding that last year's vintage in France was an exceptionally good one, that in Italy does not appear to have reached the average.

The official returns lately issued estimate the total production last year at 43,046 thousand hectolitres (947,012,000 gallons), as compared with 52,240 thousand hectolitres (1,140,280,000 gallons) the previous year, and 46,017 thousand hectolitres (1,012,374,000 gallons), the average annual production of the previous five years from 1909 to 1913 inclusive.

This shows a falling-off of 9,194 thousand hectolitres (202,268,000 gallons) from the previous year's vintage, and 2,971 thousand hectolitres (65,582,000 gallons) from the previous five years' average.

The production in Piedmont, the most important wine-growing region in North Italy, was 6,500 thousand hectolitres (148,000,000 gallons) last year as compared with 7,625 thousand hectolitres (159,830,000 gallons) in 1913, and 6,184 thousand hectolitres (136,048,000 gallons) the average of the previous five years, or 765,000 hectolitres (16,830,000 gallons less than in 1913, and 316,000 hectolitres (6,952,000 gallons) more than the average.

The principal *deficit* was in Apulia, which is one of the chief wine-producing regions in the south of Italy, which yielded only 3,350 thousand hectolitres (73,700,000 gallons) last year, as compared with 6,425 thousand hectolitres (141,350,000 gallons) in 1913, and 5,212,000 hectolitres (114,664,000 gallons), the average of the five previous years. This shows a falling-off of 3,075 thousand hectolitres (67,650,000 gallons) on the previous year, and 1,862 thousand hectolitres (40,964,000 gallons) below the average. In Sicily, the production last year was slightly more than that of 1913, and above the average of the previous five years.

THE INDUSTRIES OF BENARES.

In Benares City the only industries of importance are manufactures of brass and of cotton and silk tissues. There are over six hundred brass factories in the city, the larger concerns employing twenty or more men. The skilled artisans command high wages, and are paid according to the amount of work done. The raw material is generally imported and the alloys made on the spot; the best makers preserve the secret of the proportions of copper, zinc, and other metals used to produce brass, and also of the fluxes, colouring matter, and solders employed. Water receptacles, candlesticks, and articles for religious use, temple and house decoration, and personal adornment are the chief products. The distinctive feature of Benares brasswork is its rich golden hue. There are many goldsmiths and silversmiths in Benares who turn out silverware and jewellery of a fair order. There has lately been much imitation of jewellery in brass and German silver. The demand for these articles is chiefly local, especially among women pilgrims.

About 25,000 people are employed in the cotton and silk textile industries. The output consists chiefly of the coarser kinds of cotton cloths or muslins, either plain or adorned with stripes and floral pattern, and of silk fabrics comprising every variety of silk except velvet, and ranging from the very coarse and undyed to the most elaborate brocades. These latter are widely known, and are sent not only to all parts of India, but also to Europe and America. They assume an infinite diversity of form and pattern, but the groundwork is invariably of strong silk, three to seven layers of warp threads being laid down. Sometimes this is entirely hidden by a second groundwork of gold or silver thread, over which is worked a floral or other pattern.

If the pattern be omitted, the result is plain cloth of gold or silver; but in simpler specimens the silk groundwork is allowed to appear, the pattern being woven in gold or silver thread, sometimes combined with silks of various colours. These patterns are often geometrical, but in other cases a floral design is selected, the effect in the more elaborate pieces closely resembling embroidery. These fabrics are very heavy in texture and are seldom used for garments. There is a considerable output of plain and flowered silks of all degrees of fineness. Many native garments never pass through the hands of a tailor, but are woven in the form in which they are to be worn

There is also a considerable manufacture of fancy borders, usually done in bright floral patterns, for attaching to garments and caps in place of the border woven in the same piece.

Besides articles in pure silk, the looms of Benares are noted for the production of mixtures of wool and cotton, chiefly for the use of orthodox Mohammedans, who are forbidden to wear garments of silk alone. The best known is styled *Mashru*, meaning "permitted." Closely connected with silk-weaving is embroidering, partly in silk, but more commonly in gold or silver thread. About 2,000 persons are engaged in the manufacture of gold and silver thread fabrics. The genuine thread is made from pure silver, a thin bar being passed in succession through smaller and smaller holes in an iron plate until it is only one-twelfth of an inch in thickness. It is then drawn into fine wire by a wheel-and-axle apparatus, and finally flattened with a light hammer before being wound spirally round a strong silk thread. Gold thread is obtained by coating the wire with gold as it undergoes the final process of extension. Such thread is, however, used only for the best work. Adulteration by copper or even lead is frequently practised, while turmeric is often used to impart a brilliant colour to a thin coating of gold. In some cases, too, foreign thread of inferior quality, for the most part imported from Russia, is employed, but this is never used for the highest grades of weaving or embroidery. A more recent innovation is the growing importation of high-class gold thread from France, especially from Lyons. In connection with the embroidering and tailoring trades at Benares, American sewing-machines are now very largely used.

ENGINEERING NOTES.

Aeroplaning Progress in 1914.—The year 1914 was the year of the air, as none before, since Wilbur and Orville Wright first flew. The leading features are so well described in the *Times* Engineering Supplement that perhaps one may be pardoned for quoting the passage. "It was the year wherein the world and England first saw inverted flying, looping the loop, and the 'tail slide,' or backward flying; the year of the Army's inherently stable designs in Britain; the year of the first twenty-four (and reputed thirty-four) hours' flight in Germany; the year when flight was currently undertaken against winds in which no sailing yachts can venture forth; the year of flights in seventy-mile-an-hour winds by fliers who do not pretend to be 'star pilots'; the year when heights of five miles, measured vertically, were scaled or closely approached by both French and Germans; the year when a British single-seater biplane exceeded all previous speeds of travel with 135 miles an hour air speed; the year when the factor of safety of certain aeroplanes was put up to eight times the load of ordinary flight. During the year by far the fastest stable biplane for its power, the BE, was adopted in large quantities by the Army and ordered from ten or a dozen large engineering firms, while many more have been adopted by the Navy. It was in 1914 that no fewer than nineteen persons flew together in one huge aeroplane of Russian make, some four of which are reported in use in Poland. Such a list as the above of aeronautical events and of changes effected in twelve months comes as an astonishment even to those who are immersed in the subject. For example, few are aware that an Army-built stable aeroplane has climbed into the heavens at the rate of 1,700 ft. in a minute—a rate of ascent four times as fast as an express lift in an American hotel. Again, while we have deplored the accidents to our fliers, it is not widely known that the number of accidents in Britain last year was quite trivial compared to the number in Germany, where it was reported that over three months in the spring the fatal accidents averaged one a day. Our impression of a year's interval in retrospect is largely based on the number of occurrences it contains, because such events give a long perspective, which dies away into the haze of things forgotten. From the fewness of dramatic incidents, such as fatal accidents, the aeronautical year shows, perhaps, no great vista or perspective; by the multitude of advances achieved and discoveries published, on the contrary, a great deal of history has been made."

The First Locomotive.—The first public railway opened was the Stockton and Darlington in 1825. It was the beginning of the line afterwards called the North-Eastern Railway, and in this connection a book has just been published entitled "The North-Eastern Railway," by W. W. Tomlinson. From this and other sources an outline history may be gathered. Going back to the origin of the locomotive, Solomon de Caus, a Frenchman, in 1641 proposed working carriages by steam, and so worried the authorities of the day that they shut him up in a madhouse, so that the lunacy of one century became the good sense of another. Savery later, James Watt in 1759 and again in 1784, Cuguot in France in 1763, Moore in 1769, Evans in America in 1773, Murdoch in 1784, Symington in 1786—all were feeling their way to a workable locomotive, but without success. Meantime rails had been introduced for horse-drawn vehicles, and Richard Trevethick, who was the real father of the locomotive which could draw a load, exhibited one in London on rails in 1808. It must be remembered that the idea of making an engine go by forcing its wheels round, as in the present-day locomotive and motor-car, was quite unfamiliar to the men of that time; thus it was that the cogwheel was tried by Blenkinsop, but it was found that the same result could be achieved by adding weight, and so gaining the necessary adhesion. In 1825 Timothy Hackworth's locomotive of 6½ tons for the Stockton and Darlington Railway, and George Stephenson's "Rocket" for the Liverpool and Manchester, where success was

finally attained in 1830, were constructed. It is a far cry to the 380-ton triplex cylinder Mallett engine on the Erie Railway of to-day. Outside the invention of printing, there is no mechanical revolution approaching this.

The Hutson Ford Turbine.—This turbine was described by Mr. E. Hutson before the Junior Institution of Engineers. The steam enters through a kind of slide-valve having an expanded nozzle, passes through the blades on the rotor, and leaves by a port on the opposite side of the casing. The centre line of the steam and exhaust ports is a tangent to the rotor, so that the high-velocity steam travels across the rotor in as nearly a straight line as possible. After leaving the exhaust of the first stage the steam is conducted to a second stage rotor of greater area, and so on till the final exhaust is reached. A number of nozzles are in action at the same time. The rotor blading is composed of two alternate zigzag forms, one having steeper angles than the other, so that a succession of alternating and expanding contracting channels is formed. These blades are pressed out in the form of a ring and slipped on the rotor-drum a row at a time. The guide-blades form, in conjunction with the working blades, a series of expanding nozzles, which increase the velocity of the steam after it has impinged on the working blades, the steam thus giving a succession of impulses to the rotor from the inlet to the exhaust. These guide-blades are fixed to the rotor and revolve with it, so that the steam pressure on them, as well as on the working blades, is transferred to the shaft. To change the direction of rotation a wheel is turned which reverses the steam and exhaust ports, whereby the direction of the flow of the steam through the blades is reversed. The report comes from the *Times*.

Birmingham Power-plant.—We learn from *Electrical Engineering* that the Birmingham Corporation has decided to put down a temporary generating station to deal with the enormous number of applications for electric power that are coming in, mainly from manufacturers of war material, pending the completion of a large new station at Nechells. The present plant will be sufficient for this winter, and the temporary station is to provide for the winter load of 1915–16. The permanent Nechells station is expected to be ready for the winter of 1916–17. The temporary plant will be of 10,000 kilowatts capacity, and will be put upon a site adjoining the Nechells works in a way that will not interrupt the contracts now in hand. The estimated cost of the plant amounts in all to £97,000. The following plant has been already ordered: six marine type water-tube boilers, from Babcock and Wilcox, Limited; two 5,000-kilowatt turbo alternators, with condensers, from the British Westinghouse Electric and Manufacturing Company, Limited; and five cooling towers from the Davenport Engineering Company. The rest of the plant for which contracts are to be placed comprises coal conveyers, feed-pipes, piping and valves, switch-gear, cables, etc. The cost of temporary foundations and buildings is estimated at about £10,000; but all the plant with this exception will be incorporated into the Nechells station when the plant therein is sufficiently advanced to permit of its being released. In view of the extreme urgency, the work is being proceeded with in anticipation of the sanction of the Local Government Board to the necessary loan.

The Malleable Iron Industry.—This dates from a patent obtained in 1804 by an Englishman, Samuel Lucas. In the United States, Seth Boyden first made malleable castings in Newark, New Jersey, in 1826. About two hundred and fifty firms in this country now produce malleable castings, the total output being about 1,000,000 tons per year. The industry is almost exclusively an American one, malleable iron being made in Europe only on a very limited scale. The most rapid growth in the industry has occurred during the past twenty years. In that time malleable iron has almost entirely replaced cast iron in freight-car construction and in agricultural manufacture. A good malleable iron should have a tensile strength of 35,000 lbs. to 55,000 lbs., or even 60,000 lbs. per square inch, with an elongation 3 per cent. to 8 per cent. in two inches. The above statements are taken from a paper on malleable iron read recently by J. P. Pero at the Chicago meeting of the American Foundrymen's Association. Mr. Pero further says: "Its greatest advantage is the fact that the metal is not subject to crystallisation or fatigue, but will stand as severe a test after twenty or twenty-five years of use as it will when originally made, no matter how great the vibration may have been to which it has been subjected. If proper care is used in its manufacture, it should be quite free from internal flaws, such as blow-holes or shrinkage flaws, while it will stand considerable abuse and distortion before breaking, is much more rigid, and will resist the tendency to become distorted to a greater extent than either drop forgings or steel castings of the same sections. Malleable iron also resists rusting or corrosion very much better than either wrought iron or steel, running only slightly below cast iron in its resisting qualities to oxidation."

CORRESPONDENCE.

THE DECORATIVE TEXTILE INDUSTRIES AND THE DESIGNER'S RELATION THERETO.

In my paper on the Decorative Textile Industries I somewhat severely criticised the Schools of Art, and I should have been much surprised if this criticism had passed unchallenged. Indeed, I was hoping it would not, that I might have a better opportunity of demonstrating their weakness.

I therefore have to thank Mr. Chas. A. Eva for his letter which gives me this opportunity. In entering the lists he has been rather unfortunate in his selection of Mr. Frank Warner as a champion of his cause. This gentleman has been working for many years past in attempts to reform these schools, and whatever isolated quotations may be taken from his various addresses they are surely negatived by such a remark as "I am reluctantly compelled to admit that Art training in design stands out to-day as our weakest spot." He and the departmental committee of inquiry into the functions and practical working of the Royal College of Arts made an unqualified condemnation of this institution. This was in 1910, but still it goes on its way entrenched behind vested interests and Government officialdom, entirely indifferent to our industrial economy and the British taxpayer's purse.

May I give my own experience of this institution as an instance of its futility as a training ground for Art industry? Some three years ago I was in need of an efficient assistant, and made application at the College. I was interviewed by the design master, a professional architect, and he assured me that he had several National scholars who had finished their course of study and who would meet my need in every possible way, but what salary was I prepared to give? I said I was prepared to give £5 per week to a competent man, and was duly supplied with a young fellow who commended himself to me as having, before gaining his scholarship, served some apprenticeship in the studio or "drawing shop" of a Manchester printer. It did not take me long to discover that his artistic and technical knowledge of cotton printing had lain fallow during his college days, indeed interest and ability in this direction, rather than being developed, had become obscured by all the varied and perfunctory studies of other industrial arts and crafts. Needless to say I could not keep this man at £5 per week, and in discharging him, after a month's trial, I wrote to the headmaster to the effect that he could have little knowledge of my requirements, and much less of the commercial value of his trained students.

This particular instance is one of many that are coming to my notice from other people who have tried to employ these National scholars.

I am convinced that an academic institution such as this should not undertake to supply Art industry with well-paid workers in any branch of it.

Mr. Eva commences his letter by saying that "The aim of the Schools of Art is to provide a sound basis for all branches of Art." My reply to this is that it is impossible under the Schools' present government to provide a sound basis for *all* branches. It would be absurd to expect it, leaving outside the influence of fashion and the "latest craze." How is it possible for a master of design outside trade, and bred of a race of teachers, to attempt to inculcate anything more than his limited knowledge? It would be presumption for the Board of Education or any municipal council to expect to find a teacher well equipped in the requirements of his particular industry to give his services for the remuneration that is usually given to the Art teacher. We cannot expect it. But employers of artistic labour ought surely to be able to look to the schools for a supply of efficient draughtsmen "on tap," as Mr. Eva so cleverly puts it.

I detect also in his remarks an insinuation that an employer like myself is only out for cheap and journeyman labour. He asks: "After these students have been tapped, what will become of them?" He also asserts "that those students who supply textile producers with sketch designs at twenty shillings each, probably make more money than they would in a design studio." Both question and assertion are the result of a refusal to consider what I had been at some pains to point out in my paper. While disparaging the efforts of those who attempt the difficult task of organising labour in a studio, he says that the need is for *more* studios to which, as in Paris, the student can go with more certainty of employment.

I would ask him to read my paper with a little more care, and so dispel the notion that the facts I quoted about German designs are misleading. He must, moreover, give me credit for a full appreciation of what the Schools of Art have done towards a better knowledge of Art. This is unquestionable. To confuse my candid and practical criticism with anything like an abuse of the schools and the Art master shows a lack of discrimination. This coming from an Art master confirms me in the belief that the Schools of Art are employing men out of sympathy with any effort to bring about a better understanding between trade and Art, and that the students under their guidance are being taught to discredit the trade that is to provide them with a livelihood.

To those designers who have been labouring for years in intimate association with trade, trying to better the difficult conditions that exist for all artists concerned, it is discouraging to find those who will not lift a finger to help to protect from utter annihilation what Art there already exists in industry. We who are still fighting for the just claims of the artist have a right to expect the support and help of our Art Schools and masters, and the students have a right to look for employment in efficient trade studios, where their efforts will not be scattered and dissipated. It is a well-known fact, of which Mr. Eva has full cognisance, that apprentices employed in trade studios are invariably those students who gain the prizes for pattern design in the Schools of Art. Let me here give the reason. Apart from their designs being more technically practicable, they have learnt how to draw with refinement and precision. In other words, they are workmen who know their job.

Until, therefore, the Schools of Art will insist on a much higher standard of excellence in draughtsmanship and drop the idea of "providing a sound

basis for all branches of Art," they will remain discredited by industries calling for the specialised worker. To effect this end our Schools want entire reorganisation, and, as insisted upon in my paper, a more potent centralisation of certain and specific industries in whatever districts they can serve best. The principals must make it a *sine quâ non* with all students who enter for training that they remain a full term of years, so preventing the "half-baked" production that is now exhausting the patience of industry by his incompetency.

ARTHUR WILCOCK.

With reference to the Schools of Art as a source of design supply for the decorative textile trades, may I, as a representative of Messrs. Story & Co., give expression to one or two points which I feel may help, in some small measure, to push on toward realisation, a point, I took it, which Mr. Arthur Wilcock wished to convey in his lecture last week?

As buyer for a firm who have done a good deal in the way of producing printed and woven fabrics, I do find that the quality of designs, as turned out by students from the Art Schools, leaves very much to be desired, and, though admitting that in many cases we get originality, the lack of technical education makes it imperative on the producer to hand the design over to a practical designer to re-do, or to make it sufficiently clear for the printer to work from.

I think if some organised efforts were made whereby the student could, before launching these unfinished designs on the market, get the finished technique of the designs of some of our organised studios in London, and also of the Paris designers, it would raise the standard of work and save many a student from falling out from what ought to be a lucrative vocation.

There ought to be, in my opinion, some teacher at each school who has made himself cognisant of what the printers' possibilities are, and by this I mean has obtained some practical knowledge by a course of actual study at some well-known print works, and also visited the London and Paris retail houses with a view to seeing the latest productions and to becoming acquainted with all the novel effects which are annually sprung on the market.

As one who annually visits Paris for designs and sees the wonderful collection the Frenchmen get together, as compared with the few designs most of our English artists show, I can only feel what a big thing might result by some organised effort. It must be admitted that the average artist finds the commercial part of the business irksome. Therefore I think if he could be helped by some of his more commercial artist friends, we should thus keep in our own country much of the trade for which our Continental producers find England a good market. We have plenty of good talent stranded for lack of organisation.

R. H. GARTON.

I fear that my views regarding the practical value of the student trained at the Art Schools of this country will not be pleasing to the gentlemen responsible for the management of these institutions. I give my opinions from the point of view of the producer, and from the commercial, and also, I think, a little from the artistic standpoint. The last of these points of view, however, is possibly of no value in this discussion.

I have always made it a rule, up to the present, to examine carefully all designs that are brought to me, and this rule I have faithfully carried out, and I have found it a wise thing to do. There is, however, one class of designer that comes to me whose work I am forced now to consider an absolute waste of time to examine, and that class is the student trained at the Art Schools. I speak from experience, as I have carefully examined many hundreds of drawings made by these students, and I can truthfully say that I have never once found a single design that contained, in my opinion, any commercial utility or artistic ability. It appears to me that the fault lies in the fact that the students are almost incapable of drawing from Nature; they can, no doubt, copy a vase or similar object, but cannot draw a rose or other flower truthfully.

This fact appears to me to limit them to the modern Continental design, which type is of no commercial value at the present moment in the print trade. It seems to me a great pity that this situation is allowed to continue, as it should be an easy matter to alter. I have also noticed an absence of practical knowledge regarding the sizes of blocks and rollers, and the general method of drawing up designs for prints in such a form that they are intelligible to a blockcutter or practical printer.

I am very sorry to have to offer such a poor opinion of the Art Schools' students from a producer's standpoint, but I can only put things as I find them.

I only hope that I have been unlucky in not seeing the best students, but since so many people call on me with designs, I fear this is not the case.

ERIC NEWMAN
(Of Messrs. Newman, Smith & Newman).

OBITUARY.

BERNARD LE NEVE FOSTER, J.P.—Mr. Bernard Le Neve Foster, who died suddenly on February 21st, was the seventh of the eight sons of Peter Le Neve Foster, who was Secretary of the Society of Arts from 1853 to 1879. He was born in 1851. He was for many years a director of the well-known firm of Lincoln, Bennett & Co., the hat manufacturers, and he took a great deal of interest in that industry. He resided for many years at Sennowe Hall in Norfolk, where he made some experiments in pisciculture, a matter to which he had devoted considerable attention. He also

experimented with the cultivation of sugar beet, and in other agricultural matters. Latterly he resided at Dormans Park in Surrey. He married in 1888 Emma Elizabeth, daughter of the late John Fletcher Bennett, of the above firm. She died in 1895, leaving a family of one son and one daughter. Mr. Bernard Le Neve Foster became a member of the Society in 1880.

NOTES ON BOOKS

SVA. By Sir George Birdwood, K.C.I.E. Edited by F. H. Brown. London: Lee Warner. 1915. 12*s.* 6*d.*

Sir George Birdwood's friends—and they are very numerous—will welcome this collection of his miscellaneous writings, with its enigmatical title. Sva, however, is no word of mystic import, of thaumaturgic or occult power, but merely an etymological variant of *sua*, and implies nothing more recondite than that the author has here brought together specimens of his "very own," the writings we may take it on which he sets most store, and by which he will prefer to be judged.

Many of the articles here reprinted will be familiar to readers of the *Journal*, for a large proportion of them have appeared, in one form or another, in its pages. They all possess the quaint charm of the writer's personality, the queer "conceited" phraseology in which surely no one since Lyly, the Euphuist, has ever so much delighted; the love of pursuing a word or an idea through half a dozen tongues and twice as many writers; the tracing out of queer etymologies, often with a joyous disregard of orthodoxy and convention; the stores of curious lore gathered from Western or Eastern sources indifferently. These, and half a dozen other idiosyncracies, give Sir George Birdwood's writings a character entirely peculiar to themselves, and, when the author is content not to allow too free a rein to his caprices, lend a special charm to his treatment of subjects in themselves often technical and unattractive.

The only new contribution to the present volume is the preface, in which, after certain ambagious divagations, Sir George sets out clearly and shrewdly the views about India which he has been preaching now, may we say, for about half a century. Few men, probably, know India in the sort of way he does. He has falsified Rudyard Kipling's statement about East and West, for the two seem not only to have met, but to have been incorporated into a single personality. Though he was born in India, and was an Indian official for many years, probably the length of his service is a good deal less than that of many Anglo-Indians. But he seems to have acquired an intuitive knowledge of the Indian native, to be able to realise his point of view, to know what he thinks, to appreciate his wishes and his feelings in a way that only a few exceptionally gifted servants of the Company or the Crown have ever equalled. This makes whatever he has to say on a subject of Indian policy of special value. He may be wrong, like most of us, but at all events he can give us a view of Indian questions which does not of necessity present itself to Indian administrators, however able, however experienced.

Of course Sir George Birdwood is paradoxical in stating his views—your true Euphuist loves nothing so well as a paradox. He will not admit that we are bound, in governing India, "to seek any other end therein than the satisfaction of our own covetous and grasping needs." That presumably is the view of the Western half of his duplex personality. The Eastern half is of quite a different opinion, and "of religious inspiration" is convinced that it is incumbent on the ruling race "to subserve her material and moral advantage." When, however, it comes to the question of how the result is to be attained, East and West are in accord. Western induction and Eastern intuition lead for once to the same conclusion, and one in which many will sympathise if they hesitate definitely to agree with it. So far as one dare condense Sir George's eloquent periods, it appears to be certain that he attributes our failures—where we have failed—to the constant effort to develop Indian institutions in accordance with European ideas, instead of on Eastern models. In education, in art, in manufacture, in religion, it is always the same. We "impose our European culture upon them, not as a supplementary accomplishment, but in supersession of their own traditional learning, literatures, arts and religions." The students we have educated are only fit for Government clerks, the artists are taught to copy European methods and to neglect their hereditary styles, the manufacturers and the farmers are induced to substitute Western machines and implements for the tools and appliances sanctified by tradition, while the most religious peoples of the earth are being turned into atheists.

It is possible that our author might hardly recognise his views, thus crudely stated. Yet this is really a not unfair rendering of opinions which are held by many educated Indians, by many who know India. And in Sir George Birdwood's case, they are, in bald abstract, the ideas of a man of the widest sympathy and of the kindest nature, no friend of national congresses and popular agitations, but a man who knows and loves India and its people as few know and love them. None, too, knows better or has said more plainly that they are applicable only to a minute fraction of the huge population of India, with its numerous nationalities differing in race, customs, manners, religion and character as do the various peoples of Europe.

How the great problem of the administration of India by England will eventually be solved it is idle to try to guess, but it is quite certain that the life-work of George Birdwood has done something for its solution, and that the writings in which he has endeavoured to state at least a portion of the experience he has accumulated will do even more to help it after he has passed away.

GENERAL NOTES.

THE IMPERIAL INSTITUTE. — The annual report on the work of the Imperial Institute for 1913 shows that a large number of scientific, technical, and commercial investigations as to the composition and value of raw materials were conducted during the year. The number of reports completed in 1913 was four hundred and sixty, and at the close of the year one hundred and twenty-four investigations were in progress. Inquiries were received from nearly fifty different countries, while a large number also came from commercial firms in the United Kingdom. The work of collecting and collating the information necessary to answer these inquiries is severely taxing the staff of investigators attached to the department, and it is hoped that a separate staff, constituting a technical information bureau, may be established shortly.

SIR WILLIAM WHITE MEMORIAL FUND.—The appeal for subscriptions to this fund has resulted in a sum of £3,076 14*s.* 6*d.* having been contributed to date by four hundred and fifty-five subscribers. The committee, after carefully considering various suggestions, have decided that the most suitable form which the memorial could take would be the establishment of a research scholarship in naval architecture to be named after Sir William White, and they have accordingly arranged to hand over to the council of the Institution of Naval Architects the greater part of the funds subscribed, so that a sum of at least £100 a year shall be available for the scholarship, which will be administered by the council of that Institution. As a number of subscribers, more particularly those representing engineering societies in America and on the Continent, were anxious that their donations should be devoted to some form of memorial tablet, it has been arranged for a medallion portrait to be placed, by the kind permission of the Institution of Civil Engineers, in their handsome new building. Finally, at the suggestion of Lady White, a donation of one hundred guineas has been made to the Westminster Hospital, where Sir William White passed away. Any surplus left over after defraying the cost of the memorial tablet, the donation to the hospital, and the small charges incidental to printing and postage, will be devoted to increasing the value of the research scholarship. Additional donations can therefore still be received for that purpose.

THE TIMBER RESOURCES OF CUBA.—The forest areas of the island are mainly in the Santiago district, and although during the last decade immense areas have been cleared for cultivation, it is estimated that about one-seventh of the cultivable area of Camaguey and Oriente Provinces yet remains in primeval forests. While undoubtedly there still exists in the Cuban forests much valuable timber, they have been depleted to a great extent of those valuable woods for which there is a demand in foreign markets, especially cedar and mahogany. The Government exercises control over the forests, whether of public or private ownership, and no timber can be cut for any purpose without a permit being obtained from the chief of the Bureau of Forestry of the district in which the timber is situated. Notwithstanding the stringent laws and regulations adopted to prevent the cutting of timber on lands by persons who have no right thereto, the forests on lands belonging to the State have been robbed and in a great measure stripped of their most valuable products. Much of the land classified as forest or timberland has long since been stripped of all timber of marketable value, and at the present rate, with no effort at renewal, it will not be long until no merchantable timber will be found in the island.

THE STRAW BRAID AND STRAW HAT INDUSTRY IN CHINA.—About 6,000 tons of straw braid go from Shantung each year to foreign countries for manufacture into straw hats. The straw braid is made of wheat straw, and hence can only be produced in those parts of China growing wheat, which means the north, or, rather, that district north of the Yangtze River. Even in the wheat-growing districts there are only certain parts which produce straw braid. For instance, in Shantung Province, although wheat is grown in most districts, the production of straw braid is confined to one or two places only. The best braid is produced in the Shaho district, north of Weihsien, on the Shantung Railway. The visitor to the Shaho district at any time when the wheat is being harvested, would find the entire population engaged in stripping, cutting, or plaiting straw for straw braid. Only that part of the straw above a foot from the root can be used for braid. Pieces five and six inches in length are thus secured, cut lengthwise into a number of strips, and then dampened and plaited. The better qualities are used for first-grade braid. Brokers buy the plaited braid for shipment to Tsingtau for the foreign exporters. Labour is so cheap in China that it will probably not be many years before the bleaching, now done in England, and in normal times in Germany, will be undertaken in China, and the straw hats manufactured there at a fraction of the present foreign cost.

LORD ROBERTS MEMORIAL FUND.—In view of the wide interest which has recently been exhibited as to the future of the partially disabled sailor and soldier, an appeal is being made for the necessary funds for a considerable extension of the workshops of the Incorporated Soldiers and Sailors Help Society. In these workshops, men who have been partially disabled on active service are taught various trades, such as basket making, carpentering, carving, gilding, polishing, framing, metalwork, and electric fitting; and ten years' experience since the South African War has

convinced the committee that their scheme is the most practical one available for benefiting these men, not only pecuniarily, but also morally and physically, by keeping their minds and bodies regularly employed. Up to now, owing to lack of funds, it has only been possible to deal with this problem on a comparatively small scale; but in view of the very large number of such cases now being referred to the Society, and obviously greatly on the increase, they are convinced that they have only to lay their appeal before the public to ensure an immediate response. It is their hope that, given the necessary funds for working expenses, they will be able to obtain more commodious workshops in different localities, and by working with modern machinery, instead of entirely by hand, they will be able to create a much larger market for the men's goods than hitherto. Experience shows that for every £100 received they will be able to take in a disabled man, and to pay him an average wage of £1 per week for the first year, and £1 5s. per week afterwards. The committee also have the authority of the family of the late Lord Roberts for saying that they would welcome the proposed extension of the workshops as a memorial to the great Field-Marshal, the Countess Roberts being of opinion that he himself would have desired no greater memorial than this provision for disabled men, by means of a practical scheme in which he always took so great an interest. The Right Hon. Sir Frederick Milner, Bt., has consented to act as hon. treasurer of this Memorial Fund, and donations may be sent to him at 122, Brompton Road, S.W.; to H.R.H. Princess Christian, at Schomberg House, Pall Mall, or to Major-General Lord Cheylesmore, at 16, Princes Gate, S.W.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock (except where otherwise announced):—

March 10.—J. W. Gordon, K.C., "Patent Law Reform and the War." Dugald Clerk, D.Sc., F.R.S., will preside.

March 17. — H. M. Thornton, "The Industrial Uses of Coal Gas." Sir Corbett Woodall, D.Sc., M.Inst.C.E., Governor of the Gas Light and Coke Company, will preside.

March 24, at 4.30 p.m.—Lady Lugard, "The Work of the War Refugees' Committee." Colonel Sir Thomas H. Holdich, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Chairman of the Council, will preside.

April 14. — T. Thorne Baker, "The Industrial Uses of Radium."

April 21.—Moreton Frewen, "Profit and Loss in Our Sea Fisheries."

Indian Section.

Thursday afternoons:—

March 18, at 4.30 p.m. — Lieut.-Colonel A. C. Yate, I.A. (retired), "The Indian Army." The Right Hon. Viscount Bryce, O.M., D.C.L., LL.D., F.R.S., will preside.

April 15, at 5 p.m. — Perceval Landon, "Basra and the Shatt-ul-Arab." The Right Hon. Earl Curzon of Kedleston, G.C.S.I., G.C.I.E., will preside.

May 13, at 4.30 p.m.—M. M. S. Gubbay, I.C.S., "Indian Trade and the War."

Colonial Section.

Tuesday afternoon, at 4.30 o'clock:—

May 4.—S. Chas. Phillips, M.S.C.I., "The Empire's Resources in Paper-making Materials."

Dates to be hereafter announced: –

C. H. Sherrill, "Ancient Stained Glass."

A. S. E. Ackermann, B.Sc., Assoc.M.Inst.C.E., "The Utilisation of Solar Energy."

Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

Augustus Vernon Harcourt, D.C.L., LL.D., D.Sc., F.R.S., "On an Economical and Smokeless Grate, and on the Measurement of the Efficiency of Open Grates."

Aldred Lecture.

Thursday afternoon, at 4.30 o'clock:—

March 11.—M. Paul Lambotte, Directeur des Beaux-Arts au Ministère des Sciences et des Arts de Belgique, "L'évolution de l'école Belge de Peinture (1830–1900)." Lord Sanderson, G.C.B., K.C.M.G., Vice-President of the Society, will preside.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

M. H. Baillie Scott, "House Building: Past and Present." Three Lectures.

Syllabus.

Lecture I.—March 15.—*House Building, Past and Present.* The nature of the building art—The modern conception of building and architecture—The utilitarian spirit in house building—The house necessarily a work of art, good or bad—As such has degenerated in modern times—The old house still the best—Architecture a dangerous term, and why—No art is degraded because it is useful—The

fallacy of pure art—No pure art in nature—Art must cling to life and express itself in the service of life.

LECTURE II.—MARCH 22.—*Houses in the Past in this Country*. Three main periods: (1) The craftsman or mediæval period, when the art of building flourished; (2) The scholar, or Renaissance period, when the building art became "tongue-tied by authority"; (3) The shopkeeper, or commercial period—The distinguishing features of the three periods set forth as an allegory—The trades guilds—The spirit and methods of the old craftsmen—The scholar spirit—The commercial spirit.

LECTURE III. — MARCH 29. — *Houses of the Present*. The average house of the craftsman period adorned the world—The average modern house disfigures the world—Normal modern building a disease rather than an art—The causes and cure of this disease—Difficulties of the architect—Building by-laws—The qualities of various types of houses discussed—An ideal house described.

DAVID SOMMERVILLE, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.
April 26, May 3, 10, 17.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 8...African Society, Hotel Cecil, Strand, W.C., 8 p.m. M. Emile Vandervelde, "Belgian and British Interests in Africa."

East India Association, Caxton Hall, Westminster, S.W., 4 p.m. Sir D. M. Hamilton, "India after the War from the Economic Standpoint."

Brewing, Institute of (London Section), Imperial Hotel, Russell-square, W.C., 8 p.m. Mr. A. R. Ling, "A Review of our Knowledge of the Changes which occur in the Fermenting Vessel, Storage Vat, and Cask."

Surveyors' Institution, 12, Great George-street, S.W., 8 p.m. Discussion on papers by Messrs. J. Dixon and E. H. N. Ryde, "The Report of the Land Inquiry Committee on Rating."

Geographical Society, Burlington-gardens, W., 8.30 p.m. Professor S. Gardiner, "Our Fisheries and their Geography."

Engineers, Cleveland Institution of, Middlesbrough, 7.30 p.m.

TUESDAY, MARCH 9...Sociological Society, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8.15 p.m. Mr. S. H. Swinny, "An Historic Interpretation of the War."

Asiatic Society, 22, Albemarle-street, W., 4 p.m. Mr. F. Legge, "The Worship of Mithras and its Mysteries."

Royal Institution, Albemarle-street, W., 3 p.m. Professor W. J. Pope, "Colour Photography—Scientific Applications." (Lecture II.)

Civil Engineers, Institution of, Great George-street, S.W., 8 p.m. Sir T. Mason, "The Improvement of the River Clyde and Harbour of Glasgow, 1873-1914."

British Decorators, Institute of, Painters' Hall, Little Trinity-lane, E.C., 8 p.m. Mr. R. G. Barker, "A Comparison between Simple and Elaborate Schemes of Colour for Domestic Decoration."

Photographic Society, 35, Russell-square, W.C., 8 p.m. Messrs. A. J. Bull and A. C. Jolley, "On the Character of Selective Absorption."

Pharmaceutical Society, 17, Bloomsbury-square, W.C., 8 p.m. Dr. F. Hooper, "Trees that Weep: a Study of the Natural Exudations of Plants."

Electrical Engineers, Institution of (Local Section), 17, Albert-square, Manchester, 7.30 p.m. Mr. C. P. Sparks, "Electricity applied to Mining."

(Scottish Section.) Princes-street Station Hotel, Edinburgh, 8 p.m. Mr. E. B. Wedmore, "Automatic Protective Switchgear for Alternating-Current Systems."

Sanitary Institute, 90, Buckingham Palace-road, S.W., 8 p.m. Discussion on "Maternity and Child Welfare Schemes."

Zoological Society, Regent's-park, N.W., 5.30 p.m. 1. Mr. F. F. Laidlaw, "Contributions to a Study of the Dragonfly Fauna of Borneo." 2. Messrs. G. Arnold and C. L. Boulenger, "On a Freshwater Medusa from the Limpopo River-System"; and other papers.

WEDNESDAY, MARCH 10...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. J. G. Gordon, "Patent Law Reform and the War."

Automobile Engineers, Institution of, at the Institution of Mechanical Engineers, Storey's-gate, S.W., 8 p.m. Mr. F. W. Lanchester, "The Flying Machine—the Aerofoil in the light of Theory and Experiment."

Electrical Engineers, Institution of (Yorkshire Section), Philosophical Hall, Leeds, 7 p.m. Mr. W. R. Cooper, "Electric Cooking, mainly from the Consumer's Point of View."

Geological Society, Burlington House, W., 7.45 p.m. Special General Meeting.
8 p.m. 1. Mr. C. Reid, "The Plants of the Late Glacial Deposits of the Lea Valley." 2. Mr. S. Smith, "The Genus *Lonsdaleia* and *Dibunophyllum rugosum* (McCoy)."

THURSDAY, MARCH 11...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4.30 p.m. (Aldred Lecture.) M. Paul Lambotte, "L'évolution de l'école Belge de Peinture (1830–1900)."

Royal Society, Burlington House, W., 4.30 p.m.

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Child Study Society, at the Royal Sanitary Institute, 90, Buckingham Palace-road, S.W., 7.30 p.m. Discussion on "The Care and Development of the Child during School Age."

Royal Institution, Albemarle-street, W., 3 p.m. Sir H. Warren, "Poetry and War." (Lecture II.)

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mr. S. G. Gamble, "The Campaign against Fire."

Optical Society, at the Chemical Society, Burlington House, W., 8 p.m. Mr. R. S. Whipple, "Instruments in General Use for the Measurement of Solar Radiation."

Electrical Engineers, Institution of, Victoria-embankment, W.C., 8 p.m. Mr. W. R. Cooper, "Electric Cooking, mainly from the Consumer's Point of View."

FRIDAY, MARCH 12...Chadwick Public Lecture, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 5.15 p.m. Mr. A. Smith, "The War and the Wounded."

Royal Institution, Albemarle-street, W., 9 p.m. Sir R. J. Godlee, "Back to Lister."

Malacological Society, Burlington House, W., 8 p.m. 1. Messrs. A. S. Kennard and B. B. Woodward, "On *Helicella crayfordensis*, n. sp. from the Pleistocene deposits of S.E. England." 2. Rev. E. W. Bowell, "Further Notes on Radulæ." 3. Mr. A. Reynell, "On the editions of Swainson's Exotic Conchology."

Astronomical Society, Burlington House, W., 5 p.m.

Physical Society, Imperial College of Science, South Kensington, S.W., 8 p.m.

SATURDAY, MARCH 13...Royal Institution, Albemarle-street, W., 3 p.m. Professor Sir J. J. Thomson, "Recent Researches on Atoms and Ions." (Lecture IV.)

Journal of the Royal Society of Arts.

No. 3,251. VOL. LXIII.

FRIDAY, MARCH 12, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MARCH 15th, 8 p.m. (Cantor Lecture.) M. H. BAILLIE SCOTT, "House Building: Past and Present." (Lecture I.)

WEDNESDAY, MARCH 17th, 8 p.m. (Ordinary Meeting.) HORACE MOORE THORNTON, M.I.M.E., "The Industrial Uses of Coal Gas." SIR CORBET WOODALL, D.Sc., Past President of the Institution of Gas Engineers, will preside.

THURSDAY, MARCH 18th, 4.30 p.m. (Indian Section.) LIEUT.-COLONEL A. C. YATE, I.A. (retired), "The Indian Army." The RIGHT HON. VISCOUNT BRYCE, O.M., D.C.L., LL.D., F.R.S., will preside.

Further particulars of the Society's meetings will be found at the end of this number.

ALDRED LECTURE.

Thursday afternoon, March 11th; LORD SANDERSON, G.C.B., K.C.M.G., in the chair. The Aldred Lecture on "L'évolution de l'école Belge de Peinture (1830-1900)" was delivered by M. PAUL LAMBOTTE, Directeur des Beaux Arts au Ministère des Sciences et des Arts de Belgique.

The lecture will be published in a subsequent number of the *Journal.*

THE ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal of the Royal Society of Arts for 1915 early in May next, and they therefore invite members of the Society to forward to the Secretary on or before Saturday, March 27th, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit in promoting Arts, Manufactures, and Commerce," and has been awarded in previous years as follows:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Michael Faraday, D.C.L., F.R.S., "for discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb R.S., Chevalier of the Legion of Honour, etc., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I., "for services rendered to Arts, Manufactures, and Commerce by the realisation of the Suez Canal."

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in

aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (afterwards Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., Member of the Institute of France, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential services in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., Member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong (afterwards Lord Armstrong), C.B., D.C.L., F.R.S., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious manual labour."

In 1879, to Sir William Thomson (afterwards Lord Kelvin), O.M., LL.D., D.C.L., F.R.S., "on account of the signal service rendered to Arts, Manufactures, and Commerce by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science to industrial pursuits."

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry in the University of Berlin, "for eminent services rendered to the Industrial Arts by his investigations in organic chemistry, and for his successful labour in promoting the cultivation of chemical education and research in England."

In 1882, to Louis Pasteur, Member of the Institute of France, For. Memb. R.S., "for his researches in connection with fermentation, the preservation of wines, and the propagation of zymotic diseases in silkworms and domestic animals, whereby the arts of wine-making, silk production, and agriculture have been greatly benefited."

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S., "for the eminent services which, as a botanist and scientific traveller, and as Director of the National Botanical Department, he has rendered to the Arts, Manufactures, and Commerce by promoting an accurate knowledge of the floras and economic vegetable products of our several colonies and dependencies of the Empire."

In 1884, to Captain James Buchanan Eads, "the distinguished American engineer, whose works have been of such great service in improving the water communications of North America, and have thereby rendered valuable aid to the commerce of the world."

In 1885, to Mr. (afterwards Sir) Henry Doulton, "in recognition of the impulse given by him to the production of artistic pottery in this country."

In 1886, to Samuel Cunliffe Lister (afterwards Lord Masham), "for the services he has rendered to the textile industries, especially by the substitution of mechanical wool combing for hand combing, and by the introduction and development of a new industry—the utilisation of waste silk."

In 1887, to Her Majesty Queen Victoria, "in commemoration of the progress of Arts, Manufactures, and Commerce throughout the Empire during the fifty years of her reign."

In 1888, to Professor Hermann Louis Helmholtz, For. Memb. R.S., "in recognition of the value of his researches in various branches of science, and of their practical results upon music, painting, and the useful arts."

In 1889, to John Percy, LL.D., F.R.S., "for his achievements in promoting the Arts, Manufactures, and Commerce through the world-wide influence which his researches and writings have had upon the progress of the science and practice of metallurgy."

In 1890, to Dr. (afterwards Sir) William Henry Perkin, F.R.S., "for his discovery of the method of obtaining colouring matter from coal tar—a discovery which led to the establishment of a new and important industry, and to the utilisation of large quantities of a previously worthless material."

In 1891, to Sir Frederick Abel, Bart., G.C.V.O., K.C.B., D.C.L., D.Sc., F.R.S., "in recognition of the manner in which he has promoted several important classes of the Arts and Manufactures, by

the application of Chemical Science, and especially by his researches in the manufacture of iron and of steel; and also in acknowledgment of the great services he has rendered to the State in the provision of improved war material, and as Chemist to the War Department."

In 1892, to Thomas Alva Edison, "in recognition of the merits of his numerous and valuable inventions, especially his improvements in telegraphy, in telephony, and in electric lighting, and for his discovery of a means of reproducing vocal sounds by the phonograph."

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S., "for their joint services to scientific agriculture, and notably for the researches which, throughout a period of fifty years, have been carried on by them at the Experimental Farm, Rothamsted."

In 1894, to Sir Joseph (afterwards Lord) Lister, F.R.S., "for the discovery and establishment of the antiseptic method of treating wounds and injuries, by which not only has the art of surgery been greatly promoted, and human life saved in all parts of the world, but extensive industries have been created for the supply of materials required for carrying the treatment into effect."

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S., "in recognition of the services he has rendered to Arts, Manufactures, and Commerce by his metallurgical researches and the resulting development of the iron and steel industries."

In 1896, to Professor David Edward Hughes, F.R.S., "in recognition of the services he has rendered to Arts, Manufactures, and Commerce by his numerous inventions in electricity and magnetism, especially the printing telegraph and the microphone."

In 1897, to George James Symons, F.R.S., "for the services he has rendered to the United Kingdom by affording to engineers engaged in the water-supply and the sewerage of towns a trustworthy basis for their work, by establishing and carrying on during nearly forty years systematic observations (now at over 3,000 stations) of the rainfall of the British Isles, and by recording, tabulating, and graphically indicating the results of these observations in the annual volumes published by himself."

In 1898, to Professor Robert Wilhelm Bunsen, M.D., For. Memb. R.S., "in recognition of his numerous and most valuable applications of Chemistry and Physics to the Arts and to Manufactures."

In 1899, to Sir William Crookes, O.M., F.R.S., "for his extensive and laborious researches in chemistry and in physics—researches which have, in many instances, developed into useful practical applications in the Arts and Manufactures."

In 1900, to Henry Wilde, F.R.S., "for the discovery and practical demonstration of the indefinite increase of the magnetic and electric forces from quantities indefinitely small—a discovery now used in all dynamo machines—and for its application to the production of the electric searchlight, and to the electro-deposition of metals from their solutions."

In 1901, to His Majesty King Edward VII., "in recognition of the aid rendered by His Majesty to Arts, Manufactures, and Commerce during thirty-eight years' Presidency of the Society of Arts, by undertaking the direction of important exhibitions in this country, and the executive control of British representation at International Exhibitions abroad, and also by many other services to the cause of British Industry."

In 1902, to Professor Alexander Graham Bell, "for his invention of the telephone."

In 1903, to Sir Charles Augustus Hartley, K.C.M.G., "in recognition of his services, extending over forty-four years, as Engineer to the International Commission of the Danube, which have resulted in the opening up of the navigation of that river to ships of all nations, and of his similar services, extending over twenty years, as British Commissioner on the International Technical Commission of the Suez Canal."

In 1904, to Walter Crane, "in recognition of the services he has rendered to Art and Industry by awakening popular interest in Decorative Art and Craftsmanship, and by promoting the recognition of English Art in the form most material to the commercial prosperity of the country."

In 1905, to Lord Rayleigh, O.M., D.C.L., Sc.D., F.R.S., "in recognition of the influence which his researches, directed to the increase of scientific knowledge, have had upon industrial progress, by facilitating, amongst other scientific applications, the provision of accurate electrical standards, the production of improved lenses, and the development of apparatus for sound signalling at sea."

In 1906, to Sir Joseph Wilson Swan, M.A., D.Sc., F.R.S., "for the important part he took in the invention of the incandescent electric lamp, and for his invention of the carbon process of photographic printing."

In 1907, to the Earl of Cromer, O.M., G.C.B., G.C.M.G., K.C.S.I., C.I.E., "in recognition of his pre-eminent public services in Egypt, where he has imparted security to the relations of this country with the East, has established justice, restored order and prosperity, and, by the initiation of great works, has opened up new fields for enterprise."

In 1908, to Sir James Dewar, M.A., D.Sc., LL.D., F.R.S., "for his investigations into the liquefaction of gases and the properties of matter at low temperatures—investigations which have resulted in the production of the lowest temperatures yet reached, the use of vacuum vessels for thermal isolation, and the application of cooled charcoal to the separation of gaseous mixtures and to the production of high vacua."

In 1909, to Sir Andrew Noble, K.C.B., D.Sc., D.C.L., F.R.S., "in recognition of his long-

continued and valuable researches into the nature and action of explosives, which have resulted in the great development and improvement of modern ordnance."

In 1910, to Madame Curie, "for the discovery of radium."

In 1911, to the Hon. Sir Charles Algernon Parsons, K.C.B., LL.D., D.Sc., F.R.S., "for his experimental researches into the laws governing the efficient action of steam in engines of the turbine type, and for his invention of the re-action type of steam turbine, and its practical application to the generation of electricity and other purposes."

In 1912, to the Right Hon. Lord Strathcona and Mount Royal, G.C.M.G., G.C.V.O., LL.D., D.C.L., F.R.S., "for his services in improving the railway communications, developing the resources, and promoting the commerce and industry of Canada and other parts of the British Empire."

In 1913, to His Majesty King George V., "in respectful recognition of His Majesty's untiring efforts to make himself personally acquainted with the social and economical conditions of the various parts of his Dominions, and to promote the progress of the Arts, Manufactures, and Commerce in the United Kingdom and throughout the British Empire."

In 1914, to Chevalier Guglielmo Marconi, LL.D., D.Sc., "for his services in the development and practical application of wireless telegraphy."

PROCEEDINGS OF THE SOCIETY.

THIRTEENTH ORDINARY MEETING.

Wednesday, March 10th, 1915; Dugald Clerk, D.Sc., F.R.S., in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Baltimore, Professor Jeremiah D., Armstrong Technical High School, Washington, D.C., U.S.A.

Murphy, Joseph Plato, Zorgenhoop, West Bank, Berbice, British Guiana.

The following candidates were balloted for and duly elected Fellows of the Society:—

Kerr, Harry Roe, care of Messrs. Steel Bros. & Co., Ltd., P.O. Box 132, Rangoon, Burma.

Nuttall, Walter Harold, F.I.C., F.C.S., The Cooper Laboratory of Economic Research, Watford, Herts.

The paper read was—

PATENT LAW REFORM.

By John William Gordon, K.C.

The war which has opened our eyes to a great many obscure facts about ourselves, has also brought home to us certain facts about which there has never been any obscurity at all. Among these latter, the very evident fact that certain branches of chemical industry have been monopolised by German manufacturers has recently assumed especial interest. For it appears that this very open secret has become known to the Government, and that they propose to meet an emergency which has at the present time assumed an acute form by very heroic measures of relief. It is highly satisfactory to those of us who have been crying in the wilderness for years past, upon the subject of this and similar defects in our industrial organisation, to find that attention is being bestowed upon them in influential quarters. It is interesting, and not unimportant, perhaps, to note the theory which underlies the Government proposals as to the essential cause of our shortcoming. That theory, if I understand it aright, is that the British manufacturer is a man of short views, intellectually lethargic, a sceptic as to the practical value of technical education and scientific research, and a man to whom the pursuit of an industry involving continuous and strenuous mental activity is so uncongenial as to be impracticable. This is an interesting view of the intellectual limitations of our countrymen, and it is one which I do not propose to controvert, not even to discuss, this evening. I note it only for the purpose of taking the measure of its bearing upon the official proposals now made for dealing with the difficulties of the present situation, and, incidentally, for the purpose of satisfying this Society that it is expedient to consider in this same connection further measures than those indicated in the official programme, measures for which there will still be an urgent call, even when everything has been effected which it is possible to accomplish in the way of stimulating, instructing, and, in the full sense, waking up the sleepy and ineffective British manufacturer.

While, however, accepting this official view without cavil, it is still legitimate, on the principle of giving even the Devil his due, to recall the fact that, notwithstanding our limitations, we actually were the pioneers of technical education in the modern sense of that word. It may indeed be said, and with much probability, that our circumstances had more to do than our character with this development of our educational history. The small beginnings of technical education must be dated at the commencement of the nineteenth century, when, of all the great industrial nations of the world,

only our own was in a position to develop along those lines. The wars of the French Revolution had laid the Continent of Europe in ruins. The manufacturing industries of America were in their infancy. Russia and Japan had not yet started along the path of industrial development. The fact of British priority in this field may therefore be recorded without making any invidious claim to superiority over neighbouring peoples. Even in our own country the beginnings were small enough. The opening of the nineteenth century witnessed a great popular awakening of intellectual life in this country, of which technical education was one phase. That great movement expressed itself in the formation of numerous societies and voluntary associations of intellectually awakened people for the study of the arts and sciences. The distinctive feature of those societies was that they were non-professional and extra academical. The great majority of them have had their day, but in London there still subsists the Royal Institution, and until very lately there did subsist the London Institution, as monuments of that movement in its most comprehensive character. Outside the metropolis, but with similar scope, the Royal Society of Edinburgh and the Philosophical Societies of Glasgow, Manchester, and Cambridge, survive from the same period, and more specialised societies, like the Linnæan, the Astronomical, and the Zoological are easily identified as being products of the same intellectual movement. These societies were formed to promote, not what may properly be called technical education, but rather the scientific education of the people, and, being self-supporting and self-contained, their membership was necessarily limited to the class of people who enjoy a certain affluence so as to be able to cultivate such tastes at an expenditure of leisure and money which, speaking generally, the artisan could not command. The older technical schools, such for example our own medical schools, or the St. Bride Foundation Printing School, and the various training schools for sailors and other particular crafts, were strictly professional and based upon the economical necessity of providing professional instruction. They did not depend at all upon the intellectual enthusiasm which generated these nineteenth century societies. These latter were essentially associations of amateurs, and consequently made their appeal almost exclusively to what we may call the leisured classes.

The temper of the times, however, deeply influenced as it was by the sentiment of the French Revolution, did not tolerate the limitation of educational advantages to well-to-do people. Political sentiment, and doubtless also a keen perception that intellectual tools, as well as material implements, should be in the hands of those who can use them, led to the growth of a movement, which soon became widely extended, for the special scientific training of workmen and artisans. This movement, when fully developed, became known by the specific name of Mechanics' Institutes. The first mechanics' institute was formed in Glasgow, and still exists in a highly developed form as the Glasgow Mechanics' Institute. The foundation of that institution was due to Dr. George Birkbeck. Started by him in the year 1800 A.D., at a time when he was a professor of the Glasgow University, and being then in the nature of what we should now call university extension, it was already well enough established to be self-supporting when, four years later, Dr. Birkbeck came to settle in London as a practising physician. The success of his Glasgow undertaking led to the formation of a similar institution in London. This in time grew to be the largest of all the mechanics' institutes, and still thrives under the transparent alias of the Birkbeck College. The success of these two undertakings led to the formation of similar institutions up and down the country, and so in these voluntary mechanics' institutes the great scheme of technical education took its modest rise.

The Mechanics' Institutes movement did not, however, completely satisfy the requirements of the case. The development of the factory system of manufactures had rendered the old apprenticeship method of technical education obsolete, and the voluntary association of workmen in mechanics' institutes was not sufficient to fill the gap. What was wanted was an agency which should act upon the young recruit to the ranks of the workmen and supply him with the instruction which, under a more domestic industrial system, he would have received from his master. The discovery of this need was no novelty. So early as the year 1754 the Society for the Encouragement of Arts, Manufactures, and Commerce in Great Britain had been founded with the object, among other things and very principally, of promoting a scheme for giving instruction in drawing to children and young people of the industrial classes. The work of that Society had been continuously carried on in this and certain other directions, but for

the first fifty years of its existence its operations had been upon too small a scale to have any marked effect upon the arts, manufactures, and commerce of the realm. With the quickening of the intellectual life of the British people in the early years of the nineteenth century its activities increased very notably, both in volume and importance. The mechanics' institute scheme, although independently developed, received efficient support from that Society and, what was of even greater importance from the present point of view, the Society succeeded in establishing a system of industrial exhibitions which, growing up from small beginnings, culminated in the International Exhibition of 1851. That congress, which, for the first time, brought together for exhibition side by side the products of manufacture from every quarter of the globe, served to reveal many things to the British people and their foreign guests. Chief among the lessons so brought home was the economic value of workmen's technical schools, so that the eyes of the industrial world were opened to the great truth which the founders of the Society of Arts had somewhat prematurely, and perhaps imperfectly, perceived. So marked was the impression produced by the International Exhibition of 1851 that the American "Cyclopædia of Education," in discussing the rise of modern technical education, traces it to four principal events, the first of which is the London Exhibition of 1851. From it our own Science and Art Department took its rise in 1853. The artistic rather than the scientific side of the undertaking at first engaged attention, but later on the Livery Companies of London, awakening to long-forgotten responsibilities, took part in the new movement and established the City and Guilds' Institute, which has become the parent not only of the great science school at South Kensington, but of affiliated technical schools in all parts of the realm.

The example thus set in Great Britain was speedily followed in America, and the second of the great events to which the American "Cyclopædia" attributes the rise of modern technical education was the passing of the Morrell Act in 1862, which provided for the setting-up of technical schools in the various States of the American Union. How comparatively late a comer Germany is in this field may be seen by the circumstance that the same authority cites, as the third of these turning-points in the history of technical education, the Franco-Prussian War of 1871.

Two circumstances have concurred to draw attention to the technical education system of Germany. The first of these is the enormous development of her industrial activity—a development which has in time coincided with the establishment of the education system, and which, to a certain large extent, has been traceably due to it. The other circumstance is that the German system of technical education is highly centralised in large and fully-equipped central schools. In this respect it differs very materially from the English system of technical education, which is based upon the idea of co-operation between the school and the factory. The apparatus of instruction, under the English system, is, therefore, largely out of sight, comprising, as it does, the appliances in actual use in workshops and factories. In Germany, on the other hand, the conductors of technical schools aim at superseding the factory altogether, and at giving practical as well as theoretical instruction in their laboratories. This difference of system is, perhaps, not always sufficiently regarded when comparisons are made between the British and German institutions of technical education. However that may be, the assessment of its value does not concern us this evening. Its only bearing upon the present discussion lies in the fact that, there being this highly efficient system in successful operation in a neighbouring land, it has naturally been the object of continuous study on the part of those among our own people who are particularly interested in the subject of technical education. Thus it came about that the German system was made the subject of an important report by the Society of Arts in 1867. Also it was made the subject of very thorough inquiry by the Royal Commission already referred to, which reported in 1884—well known as the Duke of Devonshire's Commission. It furnished material for a second report by the same Commission fourteen years later.

No doubt the great development of German industry in the course of the seventeen years which have elapsed since that last report to the Duke of Devonshire, makes it expedient that the subject should now be examined anew; but it is worth while to bear in mind that, from the first, the German system of technical education has been carefully studied by educational experts in this country, and the lessons which it teaches have from time to time been noted for the information of our own authorities.

Eminent—perhaps I might even say pre-eminent—among these experts is a very remarkable man who acted as Chairman of the

Devonshire Commission—the late Sir Bernhard Samuelson—to whose great public services in connection with the department of technical education Mr. Mundella, at that time Vice-President of the Committee of Council on Education, bore emphatic testimony in the House of Commons in 1881. The following is a passage from "Hansard," reporting what was said :—

"My honourable friend, the Member for Glasgow, said that at present we have no evidence before the House of what is being done in this matter [*i.e.*, the matter of technical education]—that we have up to a certain date, 1868 – but that since that time there has been a complete revolution ; and that 1868 must be regarded as an antediluvian period, as compared with the present day. But to whom were we indebted for the information supplied in 1868, and which, at the time, was very good information as to what had been done ? We have in the volumes which have been laid on this Table as good a statement of the condition of technical education in Europe in 1868 as it is possible to obtain, and we owe it, in a great extent, to the ability, intelligence, and public spirit of my honourable friend, the Member for Banbury [Mr. B. Samuelson], who forced it upon the attention of the House and conducted an inquiry in a semi-official capacity, at his own expense, the result being that he was able to produce a report that did a great amount of good and that led to very satisfactory results. I am very glad to find that the City Guilds are now following up his example."

I cite this testimonial to Sir Bernhard Samuelson in order that it may be abundantly clear that he cannot be supposed to be in the least disposed to undervalue the importance of technical education and its bearing upon the success of our industrial undertakings. In the year 1867 all the world was looking admiringly upon the high development and great prosperity of British industry. Just as we to-day speak with respect of the technical educational institutions of America, France, Switzerland, and Germany, so in 1867 those other countries were speaking with the like respect of our widely diffused mechanics' institutes and art schools. Sir Bernhard Samuelson, who was in personal contact with our industrial neighbours while at the same time he was an enterprising industrial captain himself in this country, was by no means satisfied that these developments, which attracted the favourable notice of our neighbours, were sufficient to do justice to ourselves. At great personal trouble and expense he produced the report of which Mr. Mundella spoke in such high praise, as a State document. Subsequently, in 1882, he became the Chairman of the Royal Commission known as the Duke of Devonshire's Commission. Some fifteen years afterwards, in 1897, the same Commission, with Sir Bernhard Samuelson still at its head, produced a second report, in which the further development of the technical education and institutions of Germany was made the subject of comparison with the past and with our then existing system. By this time (1897) the interest of the British public in the subject had been thoroughly awakened, largely by the labours of Sir Bernhard Samuelson and his coadjutors, but still more by the great development of German industry, in particular along certain lines—notably, electrical machinery and chemical products, upon which technical education had a very direct and important bearing. The appearance, therefore, of the second report of the Commission to the Duke of Devonshire gave rise to an important newspaper discussion upon the whole subject of technical education and its bearing upon our industrial success. This newspaper discussion furnished the occasion for a very remarkable utterance by Sir Bernhard Samuelson, an utterance which supplies the text upon which I desire to offer a few observations this evening. It is contained in a short letter to the *Times*, which appeared in the issue of January 25th, 1897, and runs as follows :—

"In your leader on the report of my late colleagues on technical progress in Germany, you refer to the fact that the production of dyes from coal tar, in which we have been so completely distanced by the Germans, was originated by Dr. Perkin, and, it might be added, by Dr. Hofmann in this country.

"It is not generally known that we lost this manufacture because the trade in England was shut up for fourteen years by a master patent whilst no controlling patent had been sanctioned in Germany, so that anyone could take up the manufacture there ; the result being, of course, development abroad in place of stagnation at home.

"At the present time we in this country are handicapped as much as before, but from an opposition (*sic*) of things. The Germans, having taken the lead with their acquired experience and large capital, keep it by patenting their new processes in this country, but carry out their manufacture abroad. So long as they keep our market supplied, which they take care to do, nobody is at liberty to make the patented articles here."

The fact that such a man at such a time should bestir himself to direct public attention thus pointedly upon the operation of the Patent

Law is a highly significant circumstance. Its full significance can only be appreciated by considering the facts of the case to which allusion is here made. That case was an action tried in our own courts in the year 1883, and brought by the Badische Chemical Factory against Levinstein and Company, a firm of dye manufacturers in Manchester. Seldom has an action of greater practical importance been the subject of proceedings in a court of law. Some indication of the importance of this decision in an industrial sense is given by the fact that it was referred to by Sir Bernhard Samuelson in the way that I have mentioned, but for a just understanding of its importance it is necessary to examine the report of the proceedings and the practical consequences in which they eventuated.

The German patentees in that case were the inventors of a dyestuff, a chemical body having a definite chemical composition and a specific name. It may be sufficiently identified for the purposes of this evening's discussion by speaking of it as a sulpho-acid of a coal-tar product yielding red and brown dyes. The substance has an ill-sounding chemical name which, however, is of no great importance in this connection, because the chemical composition does not suffice to determine the tinctorial value of the product. That depends either upon chemical properties too subtle to be defined by even the most outlandish name or upon physical properties, the nature of which was, and probably still is, unknown. In respect of the dyestuffs which they were the first to produce, the German patentees obtained a British patent which was unquestionably good. Those dyestuffs, however, were of no appreciable commercial value, for the simple reason that the dyes produced, according to the inventor's method of manufacture, did not succeed in catching the public taste.

The patent was taken out in the year 1878, and it was five years later that the action against Levinstein came to trial. The patentees then complained that a very successful red dye which Levinstein manufactured was an infringement of their patent. In the view which the court took of the nature of the patent this claim was upheld and judgment accordingly was given in their favour. But the circumstances were very singular, and such as to place the court in a difficult position when deciding upon the issue of fact. It was proved that the dye which Levinstein manufactured could not be produced by the processes which the inventors had described, indeed could not be produced by any process which was known to the inventors. The successful dye, which was taken to answer to the chemical composition of the patented invention, was produced by a secret process, and special arrangements were made for taking the evidence in such a manner that the Levinstein secret was not disclosed except confidentially to the court and its officers. The patentee, therefore, although he was allowed to restrain the second inventor from working his own invention in this country, did not acquire a knowledge of the nature of that invention. Thus the action resulted in a deadlock, and the operation of the Patent Law in this case was to banish the manufacture of the patented dye from this country altogether. The patentee could not make it because he did not know how, the real inventor could not make it because he was restrained by an injunction of the court. So it happened that by this perverse operation of the Patent Law a patent, which had been granted with the avowed object of introducing into this country the manufacture of the sulpho-acid dyestuffs, operated to prevent their introduction. In the end the manufacture was carried on in Holland, where the German patentees had been unable to obtain a patent. It must, of course, have been communicated to the Dutch manufacturers by the inventor, and it may be presumed that he was able, thanks to the absence of patent protection in Holland, to get, in the form of a secret process, the benefit of his own invention. But, however the inventor may have profited by that arrangement, the industry in this country suffered very heavily. I am not aware that any statistics have been published from which the value of the dye industry which was thus transferred to Holland can be ascertained, but I have been credibly informed that the cloth sent from Manchester to Holland to be dyed with Blackley red represented an industry which, in the aggregate, was worth many millions of pounds. This is the instance to which Sir Bernhard Samuelson refers in his letter to the *Times*, and it merits study at the present time because what happened in 1883 might equally well happen to-day under our existing Patent Law, and Sir Bernhard Samuelson's warning is of special importance at a moment when the investment of a large sum of money is in contemplation with the object of establishing an industry similar to that which was so ruthlessly destroyed by legal process in 1883.

To appreciate the bearing of this case upon the circumstances of the hour it is desirable to

look at the facts a little more closely. I have already indicated in broad outline what was the position of the manufacturer who was held to be an infringer. It will have been fairly obvious from that outline that he was not the unresourceful and unintelligent manufacturer at whose door the failure of the chemical industries is laid to-day. But this does not rest in inference merely. Let me read to you a short passage from the judgment, in which the learned judge refers to Mr. Levinstein's part in the transaction. The Levinstein process, as I have already said, was a secret process. It could not have been learned from the patentees or from their specification because they themselves did not know how to produce the dyestuff about which they complained. Levinstein, therefore, must have brought to bear upon the problem precisely those resources which it is the object of technical education to place at the manufacturer's disposal. So much may be inferred. Now hear what the judge says, speaking with knowledge of all the facts:—

"Then the result at which I arrive is this:—The processes employed by Mr. Levinstein are processes deserving of great praise; but they are simply processes which produce exactly the same results from the same materials which are produced by this patent. The same object is pursued, the same materials are employed, the same result is obtained. I cannot do otherwise than come to the conclusion that those are merely processes, that they are not a new invention differing from the patent, but are in reality the manufacture of sulpho-acids of oxyazonaphthylamine by a process differing in some respects from the process employed according to this patent.

"I cannot come to this conclusion, I must honestly say, without some regret. I think Mr. Levinstein has employed great knowledge, great skill, and great perseverance in finding out these processes, but I am sorry to say that the law compels me to inform him that these processes cannot be used in the production of this colouring matter, seeing that the production of this colouring matter is protected by a patent."

Now, in a case like this, it is quite impossible to attribute the loss of the industry to any defect in our system of technical education. The great skill, great knowledge, great perseverance which Levinstein had brought to bear were all to go for nothing because of the impracticable working of the Patent Law. For this reason it was that, when the newspaper press had got thoroughly excited upon the subject of technical education and the British inferiority to the Germans in chemical industry, a protagonist among the advocates of technical education warned them that not only technical education but the Patent Law also must be attended to if they wished to make their industry secure. This was written in 1897, but fourteen years before, that is to say in the year 1883, a Patent Act had been passed by which provision was made, among other things, for the remedying of the mischief which this case illustrates. It is not, however, to be supposed that the draftsmen of that statute had the facts of the Levinstein case in mind. That, indeed, was impossible. The Act was passed in 1883, and the action was only tried in that year. The consequences of the decision in that action could not possibly have been known until a later date. But although it had not been illustrated on so large a scale, the mischief was perfectly well known to students of our industrial development in 1883. It is not surprising, therefore, to find that an attempt was made to remedy the mischief. Before passing to the consideration of that, and other legislative measures which have been passed into law since the date of the Samuelson letter, it will be useful to get a definite idea of the essential nature of the mischief which calls for remedy.

It has been shown that the operation of the Patent Law in the Levinstein case was to render the use in this country of a valuable invention impossible, and to banish the resulting industry to Holland. It needs no argument to show that that is a complete miscarriage. The object of the Patent Law is to facilitate the introduction of new manufactures within the realm. Whether we look upon the patent as an instrument of public policy, or as a reward granted to a meritorious inventor, the result from this point of view is the same. The merit of the inventor or the object of the policy, as the case may be, is to secure the advantage of an improvement in manufacture for the benefit of the people of this realm. In law, no less than in policy, the outcome of the Levinstein case was absurd and lamentable. How, then, could such a result come about? The answer to that question is that it came about by the operation of the rule which makes an injunction by the court the remedy for an infringement of patent right.

Patent right in its beginnings was a right which enabled the grantee of a patent to carry on some craft within the realm, in spite of the privileges of chartered craftsmen. Prior to the year 1832 a large number of corporations

existed in various parts of the country for the purpose of supervising the industries and commerce of our cities. The great companies of the City of London are survivals from a very ancient period, and to this very day the authority of the Stationers' Company to keep the copyright register is a survival—rescued by special legislation from the repeal of 1832—of the ancient privileges of the Company in respect of the printing trade. In the seventeenth century these corporations of craftsmen, guilds, and companies, as they were variously called, were established in almost every township throughout the realm. Each guild enjoyed certain monopoly rights in respect of the craft to which it belonged and within the town in which it was established. Whoever desired, for instance, to set up as a draper in Cambridge must be free of the guild of drapers in that town. Otherwise he was not allowed to embark in trade as a draper there, any more than a newcomer at the present time is allowed to set up in the business of the more strictly organised professions without first obtaining a professional qualification. In many cases the trade qualification which is now under consideration could only be acquired by the method of apprenticeship, and therefore if a candidate for craftsmanship was unable to pass through the stage of an apprenticehood he might do one of two things. That is to say, either he must abandon his candidature, or, as an alternative, he must obtain a grant from the Crown which would override the privileges of the guild. There is a very interesting illustration of this point in the "Remembrancia of the City of London" (p. 101), where appears a complaint by the Stationers' Company of a patent granted to one Woodde for printing on parchment, the complaint being that the patent enabled the patentee to set at nought the Company's charter and to encroach upon its privileges. Now in those days a patentee, who wanted to introduce a new manufacture, would find himself blocked on every side by such guild privileges. If he wanted to sell ironware in London he must get himself made free of the Ironmongers' Company, or, failing that, he must employ some member of the Company to act as his agent for the purpose of his business, or, as a third alternative, he must get a patent from the Crown which would enable him to carry on his trade in spite of the Company's exclusive privileges. It is, I think, made clear by the circumstances and language of the earliest patent grants that this was the principal motive with which inventors and projectors applied for grants of that kind. Unless he chanced to be a member of the craft with which his invention was connected he could not, without such a special grant of privilege, himself carry on the business which he proposed to set up. Even if he were a member of the necessary guild in London, that would not enable him to practise his craft in Norwich, say, or in other provincial towns where a privileged guild existed. Hence, for the establishment of a new industry which might be expected to develop in various parts of the kingdom, a special Royal grant would in any case be indispensable. Greatly as our circumstances have changed at the present date, a patent grant, as it is issued from the British Patent Office at this very time, contains the words which are appropriate to such a case. The King still grants his "especial licence, full power, sole privilege and authority that the said patentee by himself, his agents or licencees, and no others, may at all times hereafter during the term of years herein mentioned make, use, exercise, and vend the said invention within our United Kingdom of Great Britain and Ireland."

These words have seemed unintelligible to some modern lawyers, who, in the free trading conditions of the present day can discover no advantage in the Royal licence and authority, and, indeed, if the grant had contained nothing more than this it would by this time have grown obsolete, for the last legal obstacle to the establishment of a new manufacture within the realm was swept away by the Act which abolished the old corporations in the year 1832.

The patent grant, however, always contained, in addition to this enabling clause, a further clause which is in the nature of an inhibition, and which strictly commands "all our subjects whatsoever . . . that they do not at any time during the continuance of the said term of fourteen years either directly or indirectly make use of or put in practice the said invention . . . without the consent, license, or agreement of the said patentee." This inhibition was, no doubt, from the first a very valuable part of the patent grant. In later years it came to be the whole substance of the grant. Two ways of giving effect to it are known to our law. One is the old common law remedy of damages obtainable by the patentee in an action against the infringer for an invasion of the chartered monopoly. The other is the remedy, originally only obtainable in Equity Courts, of an injunction to restrain continuance of the infringement.

Of these two remedies patentees have from very ancient times, as a rule, preferred the latter, and for what, from their point of view, are very good reasons. An injunction is a legal device for stamping with the character of crime an act which intrinsically is merely breach of contract or some private wrong. An ordinary breach of contract, such for instance as a failure to deliver goods sold at the time agreed upon for delivery, gives rise to an action for damages, and the measure of relief which the court can give to the aggrieved plaintiff is the damage which he has suffered by reason of the breach. There is here a very nice adjustment of the remedy to the mischief. The parties are put, as nearly as it is possible to put them, into the position which they would have occupied if the contract, instead of being broken, had been properly carried out, and that, speaking generally, is the mild and reasonable result which the rule and procedure of the common law is designed to bring about. There is nothing vindictive or exemplary about it. Indemnity to the plaintiff who has suffered the wrong is all that the system is intended to secure.

The alternative remedy, by way of an injunction, is almost the exact reverse of this. It is based upon the rigid rule, *fiat justitia, ruat cœlum.* The court interposes its authority between the disputants, ascertains what is the right thing to be done, and then requires the defeated defendant to do that thing, not as an act of duty to his neighbour, but as an act of obedience to the court. Failure to obey is visited with the penalties, not of breach of duty, but of crime, and that crime one of the highest known to the law —namely, contempt of court, the penalty of which is imprisonment at the discretion of the judge. The substantial injury to the plaintiff has no bearing on the measure of the relief afforded under this ferocious system. When once an injunction has been issued the court is disabled from thereafter doing justice between the parties. When next the question arises, it will arise not as a complaint of private wrong, but as a charge of criminal contempt, and will have to be dealt with accordingly, without, in strict theory, any regard to the merits of the underlying controversy between the parties to the cause.

It is not surprising that with a weapon of this kind ready to hand patentees have always been more anxious to obtain an injunction than to secure an award of damages. In the times of James I., when our Patent Law first took its statutory form, the principal Court of Equity, under Parliament, within the realm, was the Privy Council which, sitting in two committees under the names of the Council Board and Star Chamber severally, exercised an equitable jurisdiction. To this tribunal the patentees had recourse, and from it they were accustomed to obtain, with fatal facility, injunctions in support of their patent rights. So oppressive did this procedure become at that time that the original Statute of Monopolies, by a provision which still stands upon the statute book and is entitled in courts of law to such consideration as is accorded to ancient statutes, declares "that all proclamations, inhibitions, restraints, tending to the instituting, erecting, strengthening, furthering, or countenancing of any grant of the selling, making, working, or using of anything within this realm is utterly void and of none effect, and in no wise to put in execution." In furtherance of this sweeping abolition of the power of the courts to grant injunctions in support of patent right, it was further provided that the force and validity of all such charters, patents, restraints, or the like, should be for ever thereafter examined, tried, and determined by and according to the common law of this realm and not otherwise. The Statute of Monopolies, like other statutable provisions for the protection of the public against the encroachments of patentees, has had an unfortunate history. Treated with contempt by the servile courts of the Stuart times, it has been simply forgotten and ignored in later times, and has never had its designed effect. In spite of its stringent provisions, the injunction is to-day what it was in the days of Elizabeth and James I., the main support of patent right, and, as the case quoted shows, it has been used in modern times with effects even more disastrous for the industry of this country than in those ancient days, when it aroused the hostility of Lord Coke and the antagonism of a reforming Parliament.

Such, stated in general terms, is the nature of the mischief to which Sir Bernhard Samuelson drew attention. To appreciate the magnitude of its effects it is necessary to recur to the narrative of events. Enough has been already said about the mischievous effect of this particular injunction upon the dyeing trade of Lancashire. In fact, however, the whole subject of chemical industry is involved, and therefore the facts with which we have to deal cover a very much larger field than this particular sulpho-acid dye, a field in fact much larger than

the field of dyestuffs, a field which is larger even than the whole chemical industry. We may, however, be content this evening to deal with that aspect of it with which we are more immediately concerned—with its bearing, that is to say, upon the proposal to establish dye manufacture upon a very extensive scale within this country.

From that point of view the important fact in the Levinstein case is, not that the manufacture of a particular dye was prohibited within the realm, but that the way of improvement was closed. The peculiar mischief of this decision was that it made it more advantageous for an inventor who improved upon the original patent to go to Holland and practise his improved invention as a secret process than to practise it in this country under the provisions of our Patent Law. To establish such a state of things was obviously cutting at the root of development. What is the use of introducing improvements and developing new inventions if the inventor is to be told that this is only an improvement, and therefore cannot be practised within this realm? A few carefully disposed patents can, under such a system, block the whole development of an industry against all the world except only those privileged people who chance to be the holders of the pioneer patents. It is a matter of no consideration that these pioneer patents themselves may be perfectly worthless for all practical purposes. It is their existence, not their merit, which constitutes the strength of the patentee's position.

This situation was clearly apprehended at a very early date in the history of the chemical industry by our German competitors. A system of blocking patents has been an organised industry with the great German manufacturing chemists at least since the year 1883, and when we hear of the large staffs which they keep employed upon research work in their factories, it is well to remember that, over and above those results of this laboratory industry which take effect in improved processes and products, there is a large output of novelties which are improvements only in a legal sense; the real value of which is that they eventuate in patents of this blocking type which close the avenues of improvement to other inventors.

It is impossible from any available data to ascertain to what extent the British chemical industry has been sapped by means of such mischievous patents, but I imagine that no one having a practical acquaintance with that industry will have any doubt that this system of sapping has been systematically and extensively developed, and that it has had an immense success. It is well that the industry and resourcefulness of the German manufacturers and of their laboratory staff should be recognised. It may be freely admitted that our own people may learn much from their German competitors in this respect; but when we are comparing the relative positions of German and British chemical manufacturers in the markets of our own country it is mere obscurantism to leave out of account this crafty and successful exploitation of our Patent Law to the detriment of our own industry.

In all these cases the cause of our weakness is the injunction. It is to be understood that, according to the practice which prevails to-day, a perpetual injunction is granted as a matter of course to protect a patentee who has successfully established his patent rights against an infringer. A perusal of the text-books might easily mislead a student of English law, for dicta are to be found to the effect that an injunction is a remedy the use of which is in the discretion of the court, and which will only be applied for good reason, that when the common law remedy is sufficient the plaintiff should be left to that remedy and no injunction should issue. If this principle were observed in practice it would secure the public against the great mischief which has been just described, but in fact these sound principles do not apply in the administration of the Patent Law. Judges have long since ceased to exercise any personal discretion in the exercise of the jurisdiction to grant injunctions in ordinary patent actions. The relief is asked for as a matter of form in the pleadings, and is added as a matter of course to the judgment, so that an injunction to restrain the use of the patented invention in any form and in any measure has come to be regarded as the legal right of a successful patentee.

Such being the mischief, we may now turn to consider what are the remedies which Parliament has provided. Leaving out of account the Statute of Monopolies which, though unrepealed, has become, as above stated, obsolete and ineffective, we find the earliest attempt embodied in a section (22) of the Patent Act of 1883. That enactment provided a remedy which has come in recent years to be well known under the style of a compulsory licence. By virtue of the provisions of the section any person interested might apply to the Board of Trade for a compulsory licence, alleging one or other of the following grounds:—

(*a*) That the patent was not being worked in the United Kingdom; or

(b) That the reasonable requirements of the public with respect to the invention could not be supplied; or

(c) That any person was prevented from working or from using to the best advantage an invention of which he was possessed.

The Board was empowered to deal with the petition and in a proper case to order the patentee to grant licences on such terms as to amount of royalties, security for payment, or otherwise, as the Board, having regard to the nature of the invention and the circumstances of the case, might deem just.

If this contrivance of a compulsory licence had been effective, it would have met the whole difficulty. It would have prevented the mischiefs which have arisen, and if an expression of opinion may be allowed in this connection, it would, I think, have placed the Patent Law of this realm in an entirely sound position and constituted it a worthy model of Patent Law throughout the world. But a very hard fate has pursued the reformers of our Patent Law. This provision, like the corresponding provisions of the Statute of Monopolies, was still-born and never produced its intended result. In the case of the Statute of Monopolies, which was admirably drafted, the mishap arose from the opposition of the Court, and the exercise under our Stuart monarchs of a royal authority which dispensed with statutes. In the case of the Patent Act of 1883 the result was due to faults of draftsmanship and these faults were three.

(1) The operation of the clause was suspended for an indefinite period of time, but a period so long that before it elapsed the statutable remedy had been itself forgotten.

(2) The machinery provided for administering the Act was novel and ineffective.

(3) The procedure prescribed involved a multiplication of proceedings and consequently inordinate expense.

It will be well to bestow a little attention upon each of these points, for they have a very close bearing upon the efficiency of all sorts of legislative reforms.

Taking the first point, it must be explained that the Act of 1883 contained in its forty-fifth Section a provision in the following terms:—

"Every patent granted before the commencement of this Act or on an application then pending shall remain unaffected by the provisions of this Act relating to . . . compulsory licences."

The idea, no doubt, was that the liability to grant compulsory licences was a burden with which it would not be fair to load the already vested rights of subsisting patentees. That view of the matter opens the door to a very interesting discussion, which, however, it would be unprofitable to pursue in the present connection. Suffice it to note the apparent reason for what turned out to be a very unfortunate exception. At the time when the Act passed, and for some years afterwards, the only patents in respect of which anybody could be interested in asking for a compulsory licence were covered by this exception, so that the intended relief took no immediate effect. An old adage reminds us that what is out of sight is out of mind, and it may be generalised into a dictum that what is out of use is very soon forgotten. So it happened that this provision with regard to compulsory licences was professionally forgotten. Not for a period of fourteen years after the date of the Act did anybody attempt to take advantage of the relief which the Act provided. In 1897 a book was published which drew the attention of lawyers to this forgotten enactment, and, following upon the publication of that book, came a series of applications to the Board of Trade for the grant of compulsory licences. By that time, however, the mischief had become very serious, and it was difficult to persuade a public, which was now thoroughly alarmed, that a remedy, which for fourteen years had done no good, could really be fraught with any remedial virtue. Hence the first attempts to utilise these provisions coincided with a serious agitation for relief in some more effective form, and under such conditions only an exceedingly available and serviceable contrivance could be made to succeed.

This brings us to the second criticism above indicated. A blind prejudice against the High Court of Justice has repeatedly in recent years led to the delegation of judicial duties to officers who are not judges. I speak of this prejudice as blind, not from any notion that the High Court is a faultless tribunal, but because it has frequently happened, as in this case, that the tribunal selected to replace the High Court is faultier still. From what has been said above concerning the mischief against which a remedy had to be provided, it will be evident that the compulsory licence was, or ought to be, intended to be an alternative to the injunction. Nothing could have been more unseemly, if it had occurred, than the issue by the Board of Trade of compulsory licences to defeat the mischief produced by perpetual injunctions. The ground usually taken by persons who advocate the

setting up of special tribunals for the administration of statutable relief is that proceedings in the High Court are expensive and dilatory. Now, whatever may be said for such a contention in some other cases, there was nothing whatever to be said for it in this. The proper time and place for the discussion of an alternative remedy is when and where the principal remedy itself is under discussion, and nothing could well be more perplexing than the procedure of this Act, which left the High Court the victim of a vicious rule concerning the granting of injunctions, and vested the remedial authority in the Board of Trade, where independent procedure involved additional expense and collateral jurisdiction gave rise to the risk of conflicting authorities. In fact, the result of this inconvenient arrangement was that inventors, the people who suffered from the injunction, took no benefit from the licence, and inventors who applied for the licence had to grope their way through the difficulties of an undeveloped and imperfectly settled procedure.

Incidentally, it has just been mentioned that the machinery prescribed by the Act involved a multiplicity of proceedings. The incidental expense arose not simply from the circumstance that proceedings were multiplied, but in a still larger measure from the circumstance that the tribunal itself was unknown. The course adopted by the Board of Trade when petitions under this Act came before it was, after preliminary discussion more or less in the nature of pleadings, to appoint an arbitrator to settle the terms of the proposed licence. The arbitrator was appointed *ad hoc*, and did not in any sense constitute a court. What view he would take of even the most fundamental questions was unknown, and in a case of any consequence, therefore, it was thought necessary to bring to bear upon him the heaviest artillery of advocacy that was available. It turned out, in the event, that proceedings before the Board of Trade were in fact quite as expensive as an action at law. If the proceedings had been a mere incident—the trial of a separate issue in an action at law—they would have added something, but something not very material, to the expense of the action. But, seeing that they had to be carried on independently of the action, there was a considerable risk of their doubling the expense. Even when the foresight of an applicant for a compulsory licence led him to take the bull by the horns and, without waiting for the patentee to bring an action, to launch his own petition, he saved no costs because, as has been already said, the proceedings at the Board of Trade were no less expensive than proceedings in the High Court.

It will now be easily understood that under these conditions the provisions of the Act of 1883 concerning compulsory licences were never tested experimentally, for, although several petitions were lodged and carried through to a conclusion, they were all carried through under such unfavourable conditions that anything more than an unsatisfactory success was rendered impossible. It is not surprising, therefore, that the agitation already referred to for a reform of the Act of 1883 should have gathered head and eventually should have prevailed in Parliament. In 1900 a Departmental Committee was appointed to consider further remedial legislation, and in particular to advise Parliament as to the adoption of the Continental provision of the compulsory working within the realm of patented inventions. The Committee reported against the compulsory working provision, and in favour of a reference of petitions for compulsory licences to the High Court. The report contained also some other suggestions, and in the ensuing year Parliament proceeded to legislate generally on lines indicated by the Committee. Instead, however, of adopting the suggestion that petitions for compulsory licences should go to the High Court, Parliament took the extraordinary course of sending them for consideration to the Privy Council. This expedient did not help matters at all. The division of authority was still as marked and as mischievous as when the petition was sent to a referee, and the practice of the Privy Council tended rather to aggravate than to reduce the costs incidental to the carrying of the petition through. So far the last case was distinctly worse than the first, and in 1907 Parliament proceeded to deal with the matter for a third time.

The Act of 1907 was closely modelled upon the German patent law. Accordingly a new remedy was introduced in the shape of a condition making the working of a patented invention within the realm compulsory. The Act of 1907, like much more of the recent work of Parliament, is rather in the nature of a legislative project than of a piece of accomplished legislation. The principle of compulsory working was enunciated, but the nature and measure of the working to be required and the conditions which furnished an excuse or imposed liability upon a patentee were left to be settled by the judges in the administration of the law.

It was probably a wise expedient on the part of Parliament to leave these matters thus in a plastic condition to be moulded and fixed by the action of the judicature. The idea no doubt was that the obligation of compulsory working would, on the one hand, discourage the practice of taking patents for the purpose of blocking an industry, and, on the other hand, would secure the development within the realm of industries which are protected by patent right. The Act has only been in operation for a period of about seven years, and it is too soon perhaps to attempt anything like an estimate upon historical foundations of its possible outcome. It may be pointed out, however, that it has not had very much effect so far upon the chemical industry. To those who have a practical acquaintance with the conditions of the problem this will not be surprising. The complications which it presents in its judicial aspects are enormous. In part they may be illustrated by the facts of the Levinstein case which have been described. In such a case as that, for instance, where there was no market for the goods which the patentee could manufacture and a large market for the infringing goods which he did not know how to make, what is the patentee's obligation under the law of compulsory working? Must he manufacture, to satisfy the law, a certain quantity of unmerchantable goods, or is he to be held liable to manufacture the improved goods whose production is the infringer's secret? A court which will say to him, you must secure the Blackley red manufacture under the penalty of losing your patent, but which at the same time granted an injunction based upon the patent to prevent the only man from manufacturing Blackley red who had the necessary knowledge —such a court would obviously be placed in a position of great embarrassment. Questions of that sort, which simply do not admit of a satisfactory solution, arise in a variety of ways out of this ill-digested scheme of compulsory working. The inherent difficulties are such that nothing would be less surprising than that it should be found in the end to be what it appears to have been in the beginning, an expedient wholly ineffective for any useful purpose.

By the Act of 1907 the Legislature at last took the obvious course of sending a petition for compulsory licence to be dealt with by the Court. Yet even here the perplexity of double proceedings was carefully preserved. The High Court was substituted for the Privy Council, not for the Board of Trade, and consequently the root of the mischief remains. It is still not possible by simple proceedings in the nature of counterclaim to bring the issue of compulsory licence before the same tribunal which tries the action. A defendant who wishes to get the benefit of the statutory relief must reply to the attack upon him not only by putting in a defence in the High Court, but also by instituting proceedings by way of petition to the Board of Trade. The proceedings must go on together but independently the one of the other, and it is conceivable that by management things might be so arranged that ultimately the petition and the action should be heard together. This, however, has never yet occurred in practice, and consequently, even under the Act of 1907, the compulsory licence provisions have had no effect upon the difficulties which arise out of the perpetual injunction.

Such being the situation which has actually arisen, it will be useful to consider the bearing of this situation upon the proposal now made to establish, in competition with the German industry, a self-sufficient industry in this country in the manufacture of dyestuffs. We may take it for granted on this occasion that no insuperable difficulty will arise. So far as research and technical education are concerned, there is not likely to be the smallest difficulty about securing, and at once securing, the necessary trained skill. Whether our own technical schools have produced a sufficient number of qualified men I do not know, but in discussing this question it must be borne in mind, that, so far as the technical chemist is concerned, technical schools are, for all practical purposes, international institutions. The young men trained in the schools of Germany and Switzerland are, and always have been, as obtainable by our manufacturers as by manufacturers abroad in any numbers in which they may be wanted. It is not, if I understand aright, in this direction that the critics of our technical educational system find fault with it. The fault they find is first with the manufacturer, inasmuch as he does not take advantage of his opportunities in this direction of securing skilled assistance, and in the next place fault is found, I suppose, with the foremen and skilled artisans in that their knowledge is not so scientific as it should be, but partakes too much of the nature of perpetuated and unintelligent tradition. Now it is obvious that both these deficiencies can be made good at no great distance of time. The employment of research chemists and skilled directors in any numbers that may be

found desirable is the sort of thing that could be effected at once by an institution such as it is now proposed to set up. On that score, therefore, the difficulty is one that can be at once and easily surmounted. The training of the artisan is, no doubt, a thing less easy to accomplish in the sense that it demands more time for its accomplishment. But with the resources of such an institution it would be easy, by internal arrangements, to secure the necessary practical and theoretical instruction, and in the course of a few months to form the nucleus, at least, of such a staff as is desired. That again, therefore, is a difficulty which at any rate a short time would dispose of.

Let us assume that all these things are done, that the works are started and in successful operation. That fact will not make any difference to the subsisting patent rights in this country of which, as it is well known, a very large proportion are held by foreigners and others whose interest it is to favour the foreign competition with this domestic industry. Now it is clear, therefore, that there will be a strong disposition to repeat the Badische coup of 1883, and then, adopting the language already quoted from the judgment in that case, we may say that notwithstanding "the great knowledge, great skill, and great perseverance" which will be brought to bear in building up these industries, the law will be invoked to say that the processes so developed cannot be used in the production of the colouring matters manufactured because the production of those colouring matters is protected by patent rights. It may at once be admitted that the new institution will be placed in a very different position from that which was occupied by the defendant in the Badische and Levinstein action. In the present case there is a possibility of applying to the Board of Trade for a compulsory licence, and if it were certain that such a proceeding would succeed it would in substance remove the difficulty. There would still be an important question of procedure to be considered, but that is probably not of sufficient importance to warrant a digression upon that topic this evening. I therefore pass that by. It cannot, however, be taken for granted that an application for a compulsory licence would succeed. The grounds on which such an application can be made are strictly limited and, in fact, very narrow. If the patentee himself takes adequate steps to supply the British market with his patented goods, then, according to the interpretation adopted by the courts of this provision of the statute, no order for a compulsory licence can be made. Now, in the case at least of important goods for which a large and profitable market exists, there seems to be no conceivable reason why the foreign patentee himself should not supply the demand. It is quite true that he may be called upon to conduct his manufacture within the realm, but he cannot be called upon, as matters stand, to grant a licence to the new institution. He may prefer to remain an active and privileged competitor with the new institution, and so, although with diminished power of mischief, may still succeed in casting his blight upon the undertaking. The carrying on of the new industry under these conditions would seem likely to be extremely fruitful of litigation, but by no means equally assured of success, for if it were possible to close any particular manufacture down as the result of a successful patent action, then it cannot be denied that nobody at the present moment is in a position to say what precise field of industry will in the end remain open to the proposed institution. This is the difficulty with which, as it seems to me, the promoters are faced. The research work of the laboratories of which we have lately heard so much has resulted in an immense and extremely intricate network of patents designed to protect, by their entanglement, the whole field of chemical industry which the Germans have made their own. Hitherto these entrenched patents have afforded very efficient protection, partly, no doubt, because the defence of the British industry has been left to the uncoordinated efforts of British manufacturers who have been attacked one at a time and beaten in detail. It does not, of course, follow that it would be equally successful against a fully-organised effort to create a British industry, but, on the other hand, nobody can be justified in asserting, as our Patent Law is understood and administered at the present time, that such a large and organised institution would have any better chance than the resolute manufacturer, like the Levinstein Company in 1883, of making an effective stand against the overwhelming brute force of a judicial injunction.

It would not be worth your while to have listened to my complaints this evening if they resulted in a mere jeremiad. It is because I hope to draw your attention to a solution of the problem that I have trespassed so long upon your patience in the way of stating it. I do not propose to bring before you any nostrum of my own, or any new project. The problem is an old one, and one which, as I venture to think

can be adequately dealt with on the accepted and established principles of English law. With your permission, I will state those principles as succinctly as I can, and will indicate how it has come about that they should have been departed from in connection with the present administration of the law. My suggestion will be that you should consider whether it would not be a useful reform to recur to those well-established and approved principles, and by legislative action if necessary, by judicial proceeding preferably, to bring back the practice of the courts to the line from which it ought never to have deviated.

In the first place, it is important to realise what the essential nature of a patent right is. In legal phrase it is a privilege, that is to say, it is a right specially conferred upon some individual, or some class, and not common to the whole society. The term "privilege" has, perhaps, a somewhat odious sound, because privileged classes or persons are, and always have been, apt to strain the limits of their privileges, and by their means to pursue illegitimate ends. But a legitimate privilege is a right that is granted, not in the interests of the privileged person alone, but equally in the interests of the community at large. For example, we grant to doctors the privilege of administering poisons in the interests, not of the doctors themselves, but of their patients. We grant to members of Parliament the privilege of making defamatory statements in the House, because it is a public interest of extreme importance that discussion there should be wholly unfettered. We grant to any man who is attacked the privilege of defending himself by all necessary violence when gentle means of defence are not available. A man who is waylaid may defend himself by violence, which, if it were unprovoked, would expose him to a civil action, or to penalties of a criminal assault. Speaking generally, it may be said that privileges are conceded, under our institutions, for the purpose of enabling persons on whom some duty is cast to discharge that duty.

This is the general principle upon which privilege is based, and this general principle applies in its integrity to the privileges which the Patent Law confers. It is largely taken for granted in the drafting of a modern patent, because it has again and again found expression in judicial statements. But in the earlier patents, when the system of granting such privileges was new, it was thought desirable to instruct not only the patentee but also the judges in the motives of the grant, these motives were set out more fully in the grant itself. An extract from a patent grant in the year 1618 will make this clear:—

"And Whereas it is supposed that the said several Engines are the proper invention of the said John Gilbert and are likely to prove of good and necessary use for the Service and Benefit of this our Realme.

"Know ye therefore that Wee

"Tendring the common Good and Benifit that may redound hereby to our said Realme and Subjects and intending to reward and recompence the Industrie Travaile and Charges of the said John Gilbert bestowed and expended in and about the investigation and fynding out of the said Inventions Engines or Instruments above mentioned and the better to encourage other of our Subjects in such lawfull and commendable Labours and Indeavors as may tend to good Use and Service in this our Realme, without just cause of Greivance to anie our Subjects, at the humble Petition of the said John Gilbert, and in consideration of the yerelie Rent in and by these Presents reserved and payable to Us our Heires and Successors,

"Of our especial Grace, certain knowledge and meere Motion, have given and graunted, and, by these Presents, for Us, our Heires and Successors, doe give and graunte full and sole Licence, Power, Priviledge and Authoritie," etc.

Ori . ally, at that date, as I have already pointe l out, a grant of authority was necessary to enable the inventor to override the chartered privileges of the craftsmen guilds. But, in fact, it went beyond that point, and conferred upon the inventor of this new device the same rights of exclusive manufacture which the chartered craftsmen themselves enjoyed in their own localities and in respect of their several crafts. In other words, the patentee was placed in the position of being made free of all the guilds up and down the country in respect of the manufacture which he was proposing to introduce, and at the same time he received a privilege which was apparently exclusive of the guilds themselves—although based on the analogy of their own privileges, so far as his own invention was concerned. Such was the original scheme of an English patent grant, and it was out of that original scheme that the modern patent grant developed. Now it will be seen that the grant of a patent right of this nature could not, it may be added that in fact it did not, preclude the Crown from making a still further grant to some other patentee which would override the first grant exactly as this had overridden the charters of the craftsmen. It was by such

means of overriding grants that the difficulty of the injunction was overcome in the early seventeenth century. A very interesting instance of that procedure occurred in connection with a very famous patent granted for the manufacture of glass, a grant specifically referred to in the Statute of Monopolies. This glass patent, when originally granted, was subject to a heavy rent to the Crown, amounting in fact to £1,000 a year. It was also subject to rents that were heavier still to mortgagees who had advanced money to the patentee to enable him to set up works. The whole result was that the adventure came to grief. The undertaking was so over-capitalised by these charges improvidently made that it could not be worked to anybody's advantage. The patentee could make no profit, and the rent chargers could not draw their revenues. From these circumstances a deadlock arose, the nature of which is not precisely known. It may very reasonably be conjectured, however, that some of the rent chargers were not willing to forego their interests or to make such sacrifices as would enable the undertaking to be placed on a sound footing. Probably what happened then was what would almost certainly happen now in like circumstances, that is to say, every one of the encumbrancers would try to shift the burden upon other shoulders, and would be so resolute in pursuing his own relative advantage that a mutual understanding would become impossible. To get over this difficulty, for the patentee was a man with great interest at Court, the King issued a second patent in respect of the same project, which authorised the grantee, who was in fact the original patentee, the encumbrancers being left out, to carry on the manufacture on his own account. This second patent was to override the first in so far as it authorised the grantee to carry on the undertaking in spite of the exclusive rights conferred by the original grant. In fact, this second patent treated the first patent in exactly the same way that the first patent had treated the charters of the guilds. The Crown forewent its rent of £1,000 a year, and, so far as the records go, it would seem that the original encumbrancers were left entirely out in the cold. What arrangements may have been made with them privately we have no means of knowing. It is not necessary to assume that any spoliation or fraud was covered by this second grant. The point of interest is that when, during this formative period of our Patent Law, the difficulty arose of an industry which was hampered by a mischievous patent, the knot was promptly cut by the grant of a licence from the Crown exactly analogous to the compulsory licence of our own days.

It will be observed, however, that here the discretionary power to grant the compulsory licence was not hedged about by strict limitations such as those which have been introduced into our modern Acts of Parliament. There is no reason to suppose that this power of the Crown to grant a compulsory licence has ever lapsed, and it is probable that if the matter were judicially investigated it would be found that the Royal Prerogative is sufficient to meet any case that can arise. It must, however, be admitted that an idea prevails at the present day that, so far as the Crown is concerned, an earlier grant overrides a later. The suggestion therefore which a study of the Constitutional question brings to light has no direct practical bearing. Before investors could be advised to subscribe capital on the faith of such a view of the law, the view itself would have to be considered by the tribunals and authoritatively pronounced upon. It is worth while to draw attention to it, because when amendments of the law are under consideration it is always of importance to ascertain what the law actually is which it is proposed to amend; but beyond that the only value of this ancient precedent is that it suggests a definite alternative to our present system which is worthy of consideration. We are led to inquire, if this is the law of the Constitution, why should the statute law impose more restricted limitations upon the power of granting compulsory licences?

The discussion of that question brings us back at once to the consideration of the nature of patent right. Is it in the nature of things a privilege of such a character that it would be impaired for the purposes of beneficent operation by being subject to a larger discretion in the Crown in the exercise of its dispensing power than the Patent Act recognises? The objects of the grant, as set out in the authentic document just quoted, are threefold:—

1. The common good and benefit to the realm.

2. Reward and recompense for the industry, trouble, and charges of the patentee.

3. The encouragement of other inventors in such laudable and commendable labours as may tend to the good use and service of the realm.

Now it is obvious, and may be taken to be generally admitted, that such an absolutely

unrestricted power of exclusive manufacture as was conceded in the Badische and Levinstein case tends directly not to promote, but to subvert the first of these objects. It tends also to produce that just cause of grievance which it was one of the declared objects of the Crown to avoid in connection with the grant. Hence it may be said, with confidence, that the relief by injunction which was granted in that case is subversive of the objects of the patent grant itself. The practical question, therefore, is not whether the power to restrain infringement by injunction shall be wholly uncontrolled, but to what extent it should be controlled. The obvious answer to this question is that it ought to be controlled to such an extent as to secure all the objects of the grant; including the avoidance of any just cause of grievance. An answer in those terms, however, is not very instructive, because the practical difficulty is to discover those rules of practice which will attain the end. One inference may, however, with confidence be drawn even from this extremely indefinite statement of the principle, and it is this: The injunction ought not to go as mere matter of course, and without consideration of the circumstances of the case. A court, when granting an injunction, ought to satisfy itself that the injunction will not cause the inconveniences which followed in the Badische case, and, therefore, something more than mere infringement ought to be established to justify a court in granting a perpetual injunction.

This view is in fact traditional with the English common lawyers, and finds its most authoritative expression in the Statute of Monopolies. Reference has been already made to that famous statute, and the passage has been already quoted which enacted that no injunction shall issue in support of patent right. The proceeding against which that enactment was directed is precisely this of an injunction which went as a matter of course, and without any regard to the special merits of the particular case. The mischief with which the Parliament of that date, with Sir Edward Coke as its leader, in connection with the passing of this statute, was concerned was the procedure adopted in the Star Chamber. It would seem that that court had adopted the practice of treating all infringement as contempt because the King's prohibition in the patent grant addressed to all and sundry, and forbidding them to make use of the invention without authority from the patentee, was taken to be of the same force as an injunction by the court itself. This undoubtedly was a more logical view than that which has obtained in more modern times, for it is difficult to see why a breach of the Royal injunction contained in an order of court should be treated as something more criminal than a breach of the Royal injunction authenticated by the Great Seal. In practice, of course, there is a good answer to the merely logical point. The judicial injunction is treated as being a matter of greater consequence than the Royal injunction simply because the judicial injunction proceeds upon a preliminary investigation into the validity of the patentee's claim. The Royal injunction, on the other hand, is issued at the mere petition of the patentee and without any full investigation of his right to the claim that he makes. The civilians, however, who supplied the controlling influence in the Equity Courts of the earlier half of the seventeenth century, had not arrived at the stage of dealing with an exercise of the prerogative in this critical spirit. That was the attitude of the common lawyers only, and this fact explains the preference that the Stuart monarchs showed for the civilian as against the common lawyers of their day. To the mind of the civilian a proclamation, or an injunction, or any other document authenticated by the Great Seal, was a thing to be implicitly obeyed. If the Great Seal had been wrongly applied there was a Chancellor who had authority, proper proceedings being taken, to cancel it. But so long as it remained uncancelled no subject, in their view, could be heard to call it in question. Hence it was that the Statute of Monopolies, which abolished this jurisdiction in theory, so far as patent rights were concerned, was framed with such vehemence as you have observed in the extract which I just now read. The same intolerance was manifested by the free English of other claims made in behalf of the Crown to exercise arbitrary power, and resulted, a little later in our history, in the abolition of the Star Chamber Court itself. It may, perhaps, be argued that, with the abolition of that court and the final disposal of the claim of the Crown to legislate by arbitrary authority, these sections of the Statute of Monopolies became obsolete. That, however, is a question which may perhaps some day have to be argued in a court of law. At any rate, it is one upon which it would be very imprudent to embark on the present occasion.

But, whatever the statutory rights of the public may be, they are ineffectual at the present time to afford protection to the public

against the mischief of perpetual injunctions improvidently granted. There is yet another line of authority which warrants the claim of the public to judicial consideration in this matter, and those authorities are to be traced in the reports of our Chancery Courts. The struggle between civilians and common lawyers, which was fierce at the time of which we have just spoken—that is to say, at the beginning of the seventeenth century—was terminated eventually by the complete success of the common lawyers. Since the Revolution of 1688 the administration of equity in the Chancery Courts has been entirely in the hands of common lawyers. No ecclesiastic has occupied the office of Lord Chancellor or Lord Keeper since 1625, and from the Revolution onwards the civilian lawyers have been limited to the Admiralty, Probate, and Divorce Divisions, to the Military Court of the Marshall, the Ecclesiastical Courts of the Bishops in their various dioceses and of the Commissioners sitting at Whitehall, and the Parliamentary Court of the Steward.

In the modern system of the administration of the law in Chancery we find, therefore, a temper entirely different from that of the Star Chamber and the Council Board prevailing, and down to the year 1852 the grant of injunctions was limited by certain well-defined rules, the base or principle of which may be stated as being that recourse was to be had to an injunction only when no other effectual remedy was available to the plaintiff who has established his grievance in a Chancery court. In all cases for which the common law provided an effectual remedy the Chancery judges refrained from interposing their arbitrary authority. The general principle was thus stated by Lord Brougham :—

"The principle which, as I humbly conceive, ought, generally speaking, to be the guide of the court and to limit its discretion in granting injunctions, at least where no very special circumstances occur, is that only such restraint shall be imposed as may suffice to stop the mischief complained of."—Blackmore *v.* The Glamorganshire Canal Navigation, 1 Mylne and Keen, 185.

Coming to a narrower and, for our present purpose, more pointed statement of the principle, we have it formulated by Lord Lindley in the following terms :—

"The very first principle of injunction law is that *primâ facie* you do not obtain injunctions to restrain actionable wrongs for which damages are the proper remedy."—London and Blackwall Ry. *v.* Cross, Law. Rep., 31 Chanc. Div., p. 369.

The careful observation of this salutary rule would obviously preclude such mischievous results as we are now discussing, and with such authority as it is possible to cite for the rule one may without presumption speak of the existing and mischievous practice as being a lapse from the sound doctrine of the English law.

Let it be supposed, then, that by some means, either by a voluntary recurrence on the part of the courts to Lord Brougham's rule, or, failing that, by legislation, we were to arrive at a satisfactory settlement of this practice, is there any reason to think that the system would work badly and would unfairly prejudice the rights of a patentee? For the purpose of discussing this question, I will assume that recourse is had to Parliament, and that an enactment has been put upon the statute book which goes in one particular beyond the older practice of the Court of Chancery. I will assume, that is to say, that the enactment provides in effect : —

(1) That no perpetual injunction shall in any case be granted to restrain infringement of a patent right, but only an injunction to stand until further order ;

(2) That no injunction shall be granted to restrain infringement of a patent right unless it is proved to the satisfaction of the court that the mischievous result to the patentee from the infringement proved is such that he cannot obtain adequate relief in respect thereof from the defendant charged with the infringement.

What would be the result upon patent rights upon such a modification of the existing practice of the Courts?

(1) It would at once put an end to the blackmailing type of patent action. In recent years a practice has grown up of bringing patent actions against perfectly innocent infringers who have no sufficient interest in the dispute to make an effective defence. For example, let it be supposed that the article is some slight article of luxury, say playing cards. The patentee, if he were to attack the manufacturer direct, would have to encounter strenuous opposition, because the business in the hands of the manufacturer may very likely be a profitable business. But if he attacks some small retailer in a provincial town, whose interest in the trade is restricted to the selling of a half-dozen packs of cards in the course of a twelvemonth, he possesses this advantage

that it cannot be worth the defendant's while to be at the considerable expense of conducting a serious defence and attending in London for a lengthy trial, merely to preserve his liberty to deal in this particular commodity. The patentee's cards, or somebody else's, which cannot be attacked, will serve his purpose almost as well, and he therefore submits without a struggle. This puts the patentee in the advantageous position of being able to advertise that he has successfully defended his patent right, and is resolved so to do again, and in that way he may seriously impair or even destroy the trade of the rival manufacturer without ever giving him the chance of fairly fighting out the issue between them in a court of law. It is quite true that the Patents Act contains a provision for dealing with threats of patent actions, a provision which can be set in operation for the purpose of getting rid of certain classes of such threats. I, however, have purposely put a case to which this statutable provision does not apply, a case in which a great deal of mischief may be done under the cover of a patent for which the patentee cannot be made responsible. Now it is clear that if no injunction could be granted, but only damages in a case of that sort, the patentee would find that type of action a very unprofitable investment. The damages in such a case which he could recover would be trivial and insufficient to cover his costs. To that extent his patent right would no doubt be depreciated in value, but it is a loss against which those of us who do not happen to be patentees will certainly not be particularly anxious to protect the privileged class.

(2) Again, in a case such as the Badische action, it is clear that the patentees would have been wholly unable to destroy the British industry which they set themselves to attack. In fact, it is probable that the result of that action would in such a case have been more satisfactory to them as well as to the defendant company than in fact it was. If they could not have obtained an injunction they would have had to be content with damages, and although it may be presumed that in the circumstances of that case the damages would have been small, they still would have amounted to something. The patentees would have taken their share, and that probably something more than a fair share in the profits of the Lancashire dyeing industry, and the industry would have remained and flourished within this realm. The persons who really would have been injured by the proposed rule in that case are the dyers of Holland, who would have been deprived of the windfall which, in fact, so strangely came their way. That again is a result with which those of us, with whom the interests of the British industry are preponderant, will see no reason to find fault. The only case, I suppose, in which a hardship could arise, is that in which an inventor would be prevented by competition from developing the full resources of his invention. Put such a case as that of the invention of a new drug—saccharine for example. Assuming it to be a completely new departure, the public has to be educated up to a knowledge of its advantages. That is an expensive business, involving the outlay of time and money, and it may be upon a large scale. An inventor who is secure of his exclusive right to manufacture, can venture to expend, or may be in a position to induce other people to expend, a large sum of money for the purpose of advertisement. He may thus be enabled to make a market, and, if his monopoly is secure enough, to obtain complete reimbursement. This, of course, is the theory on which the monopoly is economically justified. We give to the patentee a limited monopoly in order that it may be worth his while thus to serve the public, not only by putting forward a barren proposal of improvement, but also by taking the pains to cultivate the success of his idea. It may well be that in a case such as that the patentee might be unable to obtain from an infringer the damages which would indemnify him for the expenditure which he had quite reasonably incurred on the faith of his patent grant. That an injunction should protect him in such a case is both just and expedient, and therefore the rule which I have borrowed from the Chancery reports is not so rigorous as the rule laid down in the Statute of Monopolies—that no injunction shall in any circumstances be issued in support of a patent right, but only that the court must exercise a real discretion and refuse the injunction unless some special circumstances are proved to warrant it. We should then, in the case now under discussion, arrive at a very useful distinction between two wholly different types of patent grants. Reference has already been made to one of these, that is to say, to blocking patents, which are designed not to be the basis of a new industry but to monopolise the road leading into an undeveloped region of industry in order that it may be explored at leisure by the patentee. A patent of that sort would not be protected by injunction, because

the patentee would not be able to show that infringement would inflict upon him any irreparable damage of which he was entitled to complain. The only expense to which he could point as entitling him to special consideration would be the cost of his experiments. Having regard to what we are told as to the dimensions of some of the German chemical research laboratories, it cannot be denied or even doubted that the expense so incurred in experimental work, even in working out these purely mischievous patents, must be considerable. But the court would understand that that preliminary expenditure was in the nature of speculation simply, and such as to entitle the inventor to no more public consideration than if he had made an unfortunate bull or bear bargain on the Stock Exchange. Expenditure upon the building up of a business comes into a totally different category. From it, if it succeeds, the public has derived advantage, and therefore the patentee in such a case is entitled to consideration as having undertaken a public service. If it does not succeed, in the sense, that is to say, of being a demonstrated failure, then the patentee is only in the position of other people who fail in business. It is not the function of the courts to convert such failures into artificial successes. Where, on the other hand, a patentee has made his grant the basis of a trade and has built up that trade by means of the reasonable expenditure of capital in establishing and extending it, the very object of the system of patent grants is being accomplished, and it is the province of the court to see that the machinery of the patent law is kept in working order for the promotion of that result. Hence the expediency, statutes and common law rules to the contrary notwithstanding, of lodging in the courts a discretionary power to give effect to the monopoly clauses of the grant in a proper case. The question still remains, would that purpose be effected by an injunction made, not perpetual, but till further order? It may, I think, be concluded that the limited injunction would fully meet the case. It has, for example, happened, and will doubtless happen again, that a patent, supported on the first occasion when brought to trial, has been disallowed on a subsequent occasion when the defence was supported by another defendant. This is obviously a thing which is likely enough to happen, especially under the modern system, which I have described, of bringing actions first against defendants who are unlikely to make a strenuous defence. Now, in a case of that sort, and in many other cases which might be suggested, it would be obviously an equitable and convenient course to allow the defendant against whom an injunction in the first place went to apply to have it discharged. It is not the object of the administration of our law to create such anomalies as that a manufacturer shall be restrained from practising an art because of the existence of a patent which has been proved to be invalid. It is obvious from this consideration that there is much to be said, even in the case of a meritorious patentee, for granting an injunction only subject to the condition that it may be discharged if cause is subsequently shown for discharging it. The full discussion of this somewhat technical subject would, however, demand much more time than it is possible to bestow upon it this evening, and therefore I will be satisfied, having shown this partial and *primâ facie* case in favour of the proposal to leave it at that, with the expression of my own opinion that upon the whole it would be a desirable reform.

The issues which I have hoped by this evening's discussion to raise are now before the Society. The proposal to establish a large manufacturing industry under the existing conditions of the aniline dye manufacture is one which raises not only the commercial questions of capitalisation and organisation, but also, in a very pressing form, the comparatively dormant question of a reform of the Patent Law. The comparative backwardness of our manufacture in this line, easily as it is explained by the indolence, supineness, and inaptitude for this class of industry of the British manufacturer, can nevertheless be fully explained only when the pitfalls of our Patent Law are also taken into account. This Society has a traditionary interest in the Patent Law. It was a principal promoter of the Great International Exhibition of 1851, which in its turn gave rise to the first reform of our Patent Law in 1852. This Society took a prominent part in the discussion which led up to the further reforms of 1883. It was not, I think, so well represented in the discussion which preceded the Act of 1907, and if I may venture an opinion the fact goes to show that the participation of this Society in such discussions is a matter of some importance. There is no doubt that both in 1852 and in 1883 substantial improvements were introduced into the administration of our Patent Law. That the Act of 1907 made for improvement is, as I venture to think, open to much question. It

complicated our system by the introduction of incongruous elements, chiefly from the German patent code, but it left untouched the mischiefs which destroyed the British manufacture of aniline dyes, and laid us open to the misunderstanding and reprisal in foreign countries without securing, so far as I can observe, any countervailing advantage for our own manufactures and manufacturers May I, in conclusion, be allowed to express the hope that when next the Patent Law engages the attention of the Legislature the Board of Trade will have the assistance of the Royal Society of Arts in considering the objects of reform and the means by which those objects may be accomplished?

DISCUSSION.

The Chairman (Dugald Clerk, D.Sc., F.R.S.), in opening the discussion, said he was quite at one with the author in the desire to improve the British Patent Law in such a way that industries should remain in Britain. He also agreed with him in the idea that the British manufacturer was by no means the foolish person which some people seemed to think, either from the scientific or the business point of view, but was fully able to take care of himself. In fact, the British manufacturer was able to build up trade in Great Britain which was sounder than any trade in the world, including Germany. It was true that Germany had some industries in which she excelled, but on the other hand Britain was supreme in many branches; for instance, in shipbuilding, in steam engines, in steam turbines, in some forms of gas and oil engines, in textile industries, and in textile machinery. Even in some of the heavy chemical industries and metallurgical industries Britain was extremely successful; but we, of course, should try to do everything possible, by aid of a Patent Law, to make things still more successful. On some points he differed from the author. The author's idea of dispensing with injunctions seemed to him (the speaker) to be such as would cause a very great depreciation in patent property all the world over. He quite agreed it might be desirable to correct a few cases of injustice by making an injunction withdrawable when necessary, but in the main he thought an injunction was the proper remedy. In his own opinion, it must not be forgotten that the Patent Law was devised to enable a man to get the benefits of his mental property. It was not devised to give him a present or a privilege, but it was devised to confirm him in the use of his own property, and in property which would not have existed but for his inventiveness and hard work. Too many people regarded patents as a privilege. The Patent Law was an endeavour to give the inventor protection against stealing from him his invention; and therefore, if people infringed, the appropriate remedy must, it seemed to him, be an injunction. No other remedy could possibly serve the purpose of confirming an inventor in the use of his own property. He had been very much interested in the famous Badische case, but he had to admit that he could not see the hardship. It was unfortunate that one industry in Britain was hampered by the decision in that case; but it had to be remembered that similar decisions were given in all civilised countries in the world. Every country in the world, if the patent was of a fundamental nature, would confirm the patentee in the use of his invention, and would give his claims a reading as wide as they justly could, and that seemed to be very proper. He did not see any fault in the judge's decision in the Badische case. He had had a very extensive experience in the law courts of England, America, France and Germany in studying and endeavouring to uphold the rights of inventors, and he must say that if the injunction was done away with the poor inventor would get nothing at all. Taking, for instance, the first Marconi case, one would have thought, looking at it as an outsider, that here was a very great invention, one of the wonders of the world, but when it came in the law courts able counsel attempted to prove that the invention was not a great invention but a very small departure from previous knowledge. In that case there was given a description of how magnetic induction passed through ether and air without wires, and one argument was that that magnetic induction had the same effect as a wireless wave. That was absurd, but the point had to be met very fully, and it had to be proved up to the hilt that the wireless wave was a different thing altogether. He could assure the audience that however fundamental an invention might be, so far as its effects on industry were concerned, it would be found that so many human minds had been busy in the last 150 years on things not very far removed from that very matter which had now become successful, that there was always a difficulty in establishing quite logically the exact point of departure the inventor had made. If the author's point was carried out, the matter could be so whittled down that no single inventor would ever be given the benefit of an injunction. He had been in many of the leading actions dealing with inventions in Britain in the course of the last twenty years, and he could not remember one that would have been allowed an injunction according to the author's method of argument. If a man had a certain intellectual property he was entitled to secure for himself as many variations of that property as he possibly could. He (the speaker) could see no harm in that at all. With regard to the prevalence of actions where the patentee was not brought into the action, but purchasers or sellers in some remote part of the country were sued instead, such actions were generally taken because the people who owned the patent had no property in the country, and it was necessary, therefore, to deal with some person who had property in the country; but where there had been an actual

inventor and an owner of a patent who could be sued, he had never known of a case where he was not sued.

Mr. Alan A. Campbell Swinton said he had always been impressed by a remark which had been made to him by a man whom he had always regarded as one of the greatest men he had ever had to do with, namely, the late Lord Armstrong, the original founder of Armstrong, Whitworth and Co. Lord Armstrong had been profoundly convinced that the whole Patent Law was wrong, and that patents should not be granted at all. He (the speaker) did not know to what extent Lord Armstrong was influenced by the fact that, alone among all the scientific men and scientific inventors, he was a first-class business man himself, but his lordship was always impressed with the idea that the Patent Law did much more to prevent invention than to foster it. Lord Armstrong always referred to one case in particular in that connection, namely, the wire-wound gun which was now in use in this country. Lord Armstrong and Mr. Brunel both had the idea of the wire gun at the same time, and they proceeded jointly to patent it. They discovered, however, that it had been patented about a fortnight previously. That fact held up the wire gun for fourteen years, as the original patentee was not capable of making a success of it, and was not prepared to come to any reasonable terms.

Mr. D. Leechman remarked that the author himself admitted that the circumstances attending the Levinstein invention were of a very singular nature. He (the speaker) did not remember any other case where an original patentee, holding a fairly broad patent, came up against an infringer, who was found to have infringed the patent, and yet was not able to tell how the infringer did the work. Those cases must be extremely rare, and it was a very grave consideration whether they could be specially legislated for. He understood the author to suggest that such an inventor as Levinstein should be allowed to carry out his invention without the permission of the original patentee, but he would venture to put the following case: Supposing he (the speaker) obtained a concession of a number of square miles of a rich mining country of a very hilly and intricate nature, and some man found a way to a particular spot in that country and discovered a valuable mine there and proposed to work it because he could find a way and he (the speaker) could not; would anybody dare to suggest for an instant that that man was entitled to work that mine without the speaker's consent? And yet it seemed to him that the conditions in the two cases were very similar. Then the author rather complained about the Germans taking out blocking patents, but the obvious reply to that was that British inventors could go and do the same. They had the same opportunities, and if they were not clever or keen enough to follow them up then it was their own fault, and not the Germans'. He agreed entirely with the author that the compulsory licence was a very useful and proper remedy under certain conditions, and that the means for providing compulsory licences should be much easier than they were at present. He had suggested on a previous occasion that compulsory licences should be granted by the Comptroller. It was rather extraordinary that the Comptroller could revoke a patent, but could not grant a compulsory licence. There should also be opportunities given to the court to grant compulsory licences. With regard to the education of the manufacturer, his experience was that if a new industry was started a whole lot of people rushed into it who had failed in other industries, and looked very shyly at the men who really knew—the scientific men; but that sort of thing was passing away. When an industry entered into the second generation, the manufacturers who were carrying it on knew as much about it as anybody; they had been taught the business and properly trained for it, and had a good appreciation of both the commercial and scientific sides. He thought the author looked at the matter very much from the manufacturer's point of view, as distinct from the patentee's. He did not think that was right, but considered that it should be looked at from both points of views. If the injunction was to be abolished, it would mean it would have to be taken out of the Letters Patent to begin with. Therefore that would be altering the consideration which the country paid for being uniform as to those inventions. The more the consideration was reduced the fewer the inventions, and the country would suffer in consequence. The patentee of the present day was having a very bad time of it indeed. It had only to be remembered in that connection that about half of the applications for patents were never completed. Of those which were completed not one in ten had even the first renewal fee paid on it. If inventors were having such a very good time of it, and were the blackmailing bullies that the author seemed to suggest, those figures would not be true.

Mr. G. G. M. Hardingham said the paper had not dealt with the Patent Laws in the way in which he expected it would. One difficulty, for instance, under the present system was the excessive cost, and a second was as to the term, which in many cases was too short. He did not see why there should be a shorter term in this country than the rest of the principal countries, where it was very nearly sixteen years, as against fourteen years here. With regard to cost, a German patent cost £17, an English patent £7, and a United States patent 7*s*. If the United States could grant a patent for that small sum why could not Great Britain? Then, again, the United States search was far superior to our own; it embraced not only the specifications of United

States patents but of British patents and all the publications which were filed in the Patent Office there. The search in this country was very misleading. A British inventor thought that if he passed through the examination stage of the English Patent Office his invention was new, whereas that was by no means necessarily the case.

Mr. Walter F. Reid said he had learnt one thing from the paper, namely, that a judge after once granting an injunction had no power to get rid of it again. It seemed to him that was a difficulty which ought to be got over if possible by some alteration of the law, although personally he was a little doubtful about alterations of the law, as somehow or another they always turned out to be to the disadvantage of the inventor instead of to his advantage. He quite agreed with Mr. Hardingham's remarks. It was not fair that the State should declare a big profit out of the produce of the best brains of the country. There ought to be a material reduction in the patent fees, and the present time was a very favourable one to press for it. Two names had been mentioned by Mr. Swinton in connection with the wire gun, but the man whom he (the speaker) always understood to be the inventor of that gun was Mr. Longridge. It was a very curious thing that ideas did not originate always in one mind alone but in many, and that ideas seemed to come in crops, all at once. He himself had possessed a master patent. He had a patent for making smokeless powder throughout the world. He thought he had really invented it, but he had come across a little pamphlet in German in the British Museum, which had not even been cut, in which he found that a German botanist had carried out the same operation as he had subsequently found out himself. With regard to the remarks of Sir Bernhard Samuelson, he would deprecate very much attaching any importance to them at the present time. Sir Bernhard was a very great pioneer in education, but the conditions in 1881, when he made those remarks, were totally different from what they were at the present time. From a very wide experience in the matter, he (the speaker) could say that there was as much chemical ability in this country at present as was required for our industries. The author had said that the judges had either forgotten to exercise their discretion in the matter of granting injunctions, or that they had long ceased to exercise any personal discretion in the exercise of the jurisdiction to grant injunctions. But that was not the fault of the law; if the judges did not carry out the law, it was for the public to ask them to.

The Author, in reply, said that both the Chairman and Mr. Leechman had laboured the point that a patent ought to be treated as being a method of establishing and vindicating property of an intellectual kind; and that intellectual property ought, as much as physical property, to be the subject of personal rights which should be defended in the one case as effectually as in the other. That opened up an extremely large subject which it would be very interesting to debate at length, but he would call attention to one aspect of it. Physical property differed from intellectual property in the important particular that, with the exception of land, physical property could be multiplied to the extent to which it was required to supply our necessities; but intellectual property could not be multiplied. Intellectual property was in the essential nature of a monopoly, and one could not assign a piece of intellectual property to one man and say, "This is yours," without preventing another man from exercising his intelligence for the sake of acquiring the same or a similar property. Property which, in the nature of it, was a monopoly, must be subject to different proprietary rules from property which was not in the nature of an essential monopoly. That distinction was observed in all systems of law. There were in all systems of law different rules with regard to real property which was in the nature of a monopoly, because it could not be indefinitely multiplied, and commodities which could be indefinitely multiplied; and distinctions of that sort were inevitable in any system of jurisprudence. A distinction of that sort arose to which, he thought, neither the Chairman nor Mr. Leechman had attended. There must be such a distinction between intellectual property and property which could be indefinitely multiplied There must be a wide distinction which put the laws relating to the one necessarily in a different category from the laws relating to the other. He thought intellectual property might, within limits and under certain restrictions, very properly, and with advantage to the whole community, be made the subject of personal rights, but those personal rights must be defined and shaped with a view to the interests of the community, which preponderated over any personal interests. The consequence was that in some of the most valuable intellectual results no property at all ever had been or was ever likely to be granted. With regard to Mr. Swinton's remarks as to whether patents did not on the whole hinder the development of our industries, there was no doubt that in certain cases patents had tended very seriously to hamper industries. If those cases were the rule Patent Law would be a mistake, but those cases were in fact not the rule, and he thought it might be said with great confidence that those mischievous effects were all capable of being eliminated by a properly adjusted and well administered system of Patent Law. He thought nobody could seriously doubt for a moment, looking at the way in which our industries in fact are rooted in patent grants, that the Patent Law worked extremely advantageously upon the whole.

THE GROWING OF SPRING WHEAT.*

The plans made by farmers last autumn for increasing the area under wheat could not in many cases be carried out owing to the almost continuous wet weather experienced during the last months of the year. Attention is therefore now being directed to the possibilities of spring-sown wheat. The relationship between autumn and spring varieties of wheat may be briefly described.

The widespread cultivation of wheat, coupled with the well-known tendency of plants to vary with their surroundings, has led to the existence of a large number of more or less distinct types and varieties. Wheats of dry countries and of countries exposed to severe winds commonly have narrow leaves, pliant straw, bearded ears and velvety chaff, which enable them to resist drought and wind. Wheats of moist climates have broader leaves, which admit of more rapid transpiration, or passing off into the air of water taken up by the roots.

In recent years the attention devoted to crossing and selection of wheats has still further increased the number of varieties suited to particular requirements.

So far as the farmer is concerned the most important points are yield, strength, and power of resisting drought and disease. Each farmer should therefore consider which variety or varieties will best suit his own locality, and grow that which will yield him most profit. In Russia and Canada, where the winter is long and severe and the summer is a period of almost uninterrupted light, quickly-maturing spring wheats of the highest quality have been produced. When grown in this country such varieties usually maintain their characteristic early maturity, low yield and high quality.

One of the best known of Canadian wheats is Red Fife, which has been grown as a spring wheat in this country for many years. Its yield, however, is low, the heaviest crops not usually being more than 3 to 4 quarters per acre, although in a few districts yields approaching those of Squarehead's Master have been obtained. There are a number of strains of Red Fife, some of which are more productive than others. One of them, the Marquis, has proved the best of the Fifes grown in Manitoba, and is now on sale in this country. The Department of Agriculture and Technical Instruction for Ireland have also obtained, by selection, a strain of Red Fife which gives satisfactory returns in Ireland. The introduction, some few years ago, of Burgoyne's Fife (a cross between Red Fife and Essex Rough Chaff, effected by Professor Biffen at Cambridge) marked a distinct advance on the productive capacity of ordinary Red Fife. This variety still retains the fine milling qualities and early maturity of Red Fife, and is a distinctly better yielder, though not equal in this respect to standard varieties of English autumn wheats.

As regards the period required to mature, there is, in reality, no sharp distinction between autumn and spring wheats. In a favourable year, spring-sown autumn wheat will ripen satisfactorily in the earlier parts of England.

It is well known that cereals brought from an early district to a late district will ripen earlier than the produce of locally-grown seed. Hence, if it is desired to sow autumn wheat in spring, it is desirable that the seed should be obtained from as early a district as possible, and be sown before the end of February. The general unreliability of autumn wheats when sown in spring, however, has led to their almost total abandonment in favour of spring varieties, and at the present time chief reliance is placed upon certain wheats brought out by Vilmorin of Paris. These, whether sown in autumn or in spring, almost invariably reach maturity a week or two before the standard English wheats. As regard both yield and quality, they are not far short of ordinary autumn wheats. Other varieties of spring wheats, notably "April or Spring Bearded," have long been grown in England, but these older sorts are now rarely met with.

Soil.

Any soil on which autumn-sown wheat will thrive will usually grow spring wheat satisfactorily, provided it is possible to obtain a fine, mellow seed-bed which can be made fairly firm below. All cultural operations, therefore, should be directed towards this end, the object being to secure quick, uniform germination and growth, since wheat sown in spring has a comparatively short period of growth. The best results will usually be obtained after a corn or root crop. Drilling is usually to be preferred to broad-casting. After ploughing, if the furrow is fresh and loosely packed, the Cambridge or ring roller may be run over to consolidate the land, after which the harrows should be freely used so as still further to consolidate the bottom soil while leaving the top inch or two loose and fine. It will usually be found advisable to postpone rolling till the plant is up, for, in addition to further consolidating the soil and smoothing the surface, late rolling will have the effect of promoting tillering, in which spring wheats are deficient.

Manuring.

Unless the soil is highly fertile it will as a rule be advisable to apply some artificial manure, with the two-fold object of encouraging growth and hastening maturity. A dressing of ¾ to 1 cwt. of sulphate of ammonia and 2 or 3 cwt. of superphosphate per acre will usually answer the purpose. The manure should be applied before the final harrowing, or the superphosphate may be applied when harrowing after sowing, and 1 to 1½ cwt. of nitrate of soda may be top-dressed in April. If the spring is wet, and the young wheat is yellow and backward towards the end of April, nitrate of soda will prove most useful.

* Special leaflet issued by the Board of Agriculture and Fisheries.

A SIMPLE METHOD OF TESTING CORN FOR SEED.

A practical and simple way for testing the germinating power of corn intended for seed is given in an American journal, *The Outlook*.

The value of such a reliable test, which can be mastered by any intelligent pupil in a rural school, should be obvious to the British farmer. The test is made in the following manner: A piece of heavy sheeting, 5 ft. long by 9 ins. wide, is marked off into a dozen or more squares about 2½ ins. square, running through the middle of the cloth. These squares are numbered, say, from one to twelve. An equal number of ears of corn are selected for the test and numbered to correspond with the cloth. The cloth is thoroughly moistened and spread out in front of the ears of corn. Six grains of corn are taken from ear No. 1 and placed on the square of same number, germ side up, with the tips of the grain all pointing in the same direction. In the same manner six other grains taken from ear No. 2 are placed on square No. 2, and so on until all the squares are filled. When this has been done, the cloth is again moistened by sprinkling, and then carefully rolled up so that none of the grains will be displaced. A string is then tied round the centre of the roll, just tight enough to keep the grains of corn in place.

This done, the bundle is placed in a pail or bucket filled with warm water; it is set on end with the tips, or small ends of the grain, pointing downwards. Old newspapers are then wrapped round the pail in order to retain the heat. In from three to twelve hours the newspapers should be removed, the water poured off, and the pail again covered with newspapers. It should then be placed in a room, which must not get too cold at night or be allowed to freeze.

At the end of seven days, when the grains have begun to sprout, it will be an easy matter to tell which ears are fit for seed or not. It will be found in this way that some of the ears are dead, whilst others are too weak to be used for seed.

No one can select good seed by merely looking at it; he may be able to tell that some will not grow, but he can never be certain that the seed which he has selected will germinate or come to perfection.

The value of good seed is of vital importance to the nation, especially at the present time, and certainly a knowledge of how to procure it should be taught to our rural population. If the farm lad has work of interest and responsibility to do in school—work which he can see is directly related to his vocation—he is far more likely to remain on the land than to flock to the town, as is too often the case at the present time.

PRODUCTION OF QUININE IN ITALY.

A report from the director of government monopolies to the Minister of Finance gives some interesting figures concerning the manufacture of quinine and products containing that drug, at the pharmaceutical laboratories belonging to the State in Italy during the financial year 1912–13.

From this it appears that the gross receipts from this source amounted to 2,899,190·37 lire (£115,967), working expenses 1,964,916·19 lire (£78,598), leaving a net return of 934,230·18 lire (£37,369). This shows an increase of 14,467·74 lire (£578) in favour of last year's working as compared with that of 1911–12. This profit of 934,230·18 lire has been (as required by law) paid into a fund for preventing the spread of, and for relieving cases of malarial fever (*Sussidi per combattere la malaria*). Of this amount, quinine and preparations containing the drug to the value of 142,318·62 lire (£56,916) were supplied by the government laboratories, in the proportion of 98,578·80 lire, to the various communes in the Basilica, Calabria and Sardinia, and 43,739·82 lire to those in other districts throughout the kingdom which suffer from this cause.

The balance has been paid in cash in subventions to the various local authorities, the Red Cross Society of Italy for their anti-malarial campaign, as well as to many charitable institutions, and other bodies in the districts affected by this scourge.

The total output of the government laboratories for the financial year 1912–13 amounted to 71,905 kilogrammes (158,550 lbs.), of which 36,728 kilogrammes (80,985 lbs.) were quinine, and 35,177 kilogrammes (77,565 lbs.) products containing quinine. This is an increase of 1,128 kilogrammes (2,587 lbs.), and 319 kilogrammes (703 lbs.) respectively on the production of the previous year.

The total quantity of quinine sold to the public in Italy last year was 35,781 kilogrammes (78,804 lbs.). The number of places of sale was 31,602, of which 30,485 were sellers of tobacco and other articles of government monopoly.

The exports amounted to 13,223 kilogrammes (29,157 lbs.), Greece and Bulgaria being the principal destinations.

The average consumption last year, in Italy, of quinine manufactured by the State was 569 grammes (36·87 grains) per 1,000 of population, as compared with 545 grammes (35·32 grains) of the previous one.

The cost of production for all kinds of preparations and tabloids (except tannate of quinine) was 1·42 lire per kilogramme less than that of the previous year, and this in spite of the increase in the prices of the raw material.

ARTS AND CRAFTS.

War Memorials and Rolls of Honour.—An exhibition of designs for war memorials and rolls of honour is at the present moment a very practical and a very wise idea. There are not only numerous societies, parishes, institutions, and the like, whose members wish for some more or less permanent record of the names of those connected with them who are serving their country in the Army and Navy, but also many people who are faced with the difficulty

of choosing a suitable memorial to those who have fallen. It has hitherto been too much the habit here in England on such occasions for the donors of memorials to go to some firm whose name they happen to have heard of quite casually, and to take with more or less (usually more) docility what they choose to offer. This has no doubt answered admirably sometimes. We all know that some manufacturers take a pride in producing nothing but the best, but too often the result has left a good deal to be desired. That attitude of mind is by no means a thing of the past. Anyone who reads, for instance, the accounts of new stained-glass windows put into churches will be surprised to see what an unusual thing it is to find any mention of the firm or of the artist responsible for their design. Apparently the popular idea is that a stained-glass window *is* a stained-glass window, no matter whether it be good or bad. The parish may be interested in the fact that it cost so much per square foot, but they do not expect anyone to care who produced it. This is rather hard, both on artists and on those manufacturers who have a care for the artistic quality of their work, and it is a point of view which one hopes that people are outgrowing, however gradually. Meanwhile the exhibition at the Fine Art Society's galleries is an attempt to put those members of the public who desire memorials into touch with artists who are ready and willing to provide them. The collection is not large, and, of necessity, consists mainly of small mural tablets and illuminated rolls of honour, but there are a few photographs and sketches of larger and more important work. The memorial tablets shown are not for the most part specially designed for this exhibition, but are intended to indicate the kind of work which the artists submitting them are prepared to undertake. The memorial tablet by Miss Jessie Bayes, on gilded wood with an inscription from the Russian Liturgy, is very satisfactory, and Miss E. M. Rope's plaster design of angels censing, with the inscription, "Praise God for the life of ——," is full of feeling. The rolls of honour include an interesting sketch-design with a soldier on one side, a sailor on the other, and a recording angel in the lunette above by Mr. Byam Shaw; a rough but well-spaced sketch by Mr. Percy Smith; an unusual suggestion, half modern, half on the lines of an old book illumination, by Mr. Russell Flint; fine examples of script and illumination by Mr. Allan F. Vigers and Mr. Graily Hewitt; and a really charming opening page of an illuminated roll of honour decorated with an allover scroll pattern by Mrs. Louise Powell. If the exhibition only serves to make the unfortunately all too numerous people whose thoughts are now turned towards the erection of memorials realise the possibility of having something really artistic, and insist upon getting it, it will have answered a very useful purpose and have earned the gratitude of posterity, besides helping artists, who are, as is well known, by no means overwhelmed with work at present.

Lace.—Lacemaking is a craft which is very much in people's minds to-day. For some years past English women have been taking an interest in it, and in many English counties (not to mention Ireland) a quite remarkable revival of the art has taken place. On the other hand, the devastation of Belgium, and the quantities of Belgian lace which have come over to England, have reminded us very forcibly that our own hand-made lace industry is not only younger but smaller and more exotic than that of the gallant little country on the other side of the Channel. It is, therefore, a happy idea on the part of the committee of the Women's International Art Club (who are dividing the gate-money of their sixteenth annual exhibition now being held at the Grafton Galleries between the Queen's Work for Women Fund and the Belgian Relief Fund) to include amongst their exhibits a collection of lace. The co-operation of Count Lalaing and of M. Paul Lambotte, Directeur des Beaux-Arts, Brussels, has been obtained, and a great deal of fine lace has been brought together, in which are to be found some very good specimens of old Flemish lace. The show includes a certain amount of modern Belgian work, some of which is for sale, and samples of lace which Belgian workers are willing to execute at very moderate prices. This modern work is quite good of its kind, and, if the exhibition had consisted of nothing else, would probably have attracted its share of attention. The scarf in *point de flandre* lent by the Société des Arts de la Femme, for instance, is a really fine and beautiful piece of modern workmanship, and there are other very interesting examples. It must be admitted, however, that the main attraction of the exhibition lies in the older work, of which specimens are shown of dates ranging from the fourteenth to the eighteenth centuries (the earliest being, of course, *tela tirata* and not lace proper), and coming not only from Belgium but also from Italy, France, England, and Holland. No one who cares for lace could fail to be interested in the show. The exhibits are not all equally good, but the best of them are really remarkable. Beautiful Belgian lace is lent by Madame Moons, Madame de la Croix, Madame Rothschild, and others. Mrs. Herbert Cohen sends a very choice little collection of examples, mainly Italian and Belgian; Mr. Samuel Chick some very interesting and fine Angleterre lace, as well as specimens of Mechlin, Brussels, and Lille. Buckingham, Honiton, and Irish crochet are all represented, as well as the many varieties of Belgian and Italian work. Lovers of the older and rather more severe types of lace will, however, consider that the historical collection shown by Mrs. Hungerford Pollen is the crowning point of the exhibition. Every piece has some point of interest, and the lace is so beautifully kept and shown that it is a treat to look at it. The exhibition cannot but give pleasure to all those interested in lace from whatever point of view, and will repay careful study by those in any way concerned with the production of hand-made lace.

Women's Craftwork.—Exhibitions of the various societies of women artists are not as a rule, for some unknown reason, the best places for finding the most accomplished of the work executed by English craftswomen, and the current exhibitions of the Women's International Art Club and the Society of Women Artists form no exception to the general rule. On the other hand, they both include a certain amount of creditable craftwork. At the Grafton Gallery, Mrs. Phœbe Stabler exhibits some of her charming little glazed pottery statuettes, Miss Isabel Hope shows some tasteful silverwork, and Miss Ethel Virtue has a case of jewellery, some of which is rather fresh in design. On the whole, however, the jewellery both here and at Suffolk Street, where good work by Miss Rimington and others is to be seen, tends to be all very much of one type, while the prices asked, which are far lower than they were a few years ago, suggest that it must be very difficult, if not impossible, nowadays for a woman to earn her living at this kind of work. The most interesting embroidery at the Grafton Galleries is the coarse brightly-coloured work in wools by Madame Ghysbrecht and others which appears to represent a school. The workers are undoubtedly striving after something, but the results so far achieved can hardly be described as satisfactory. They suggest a kind of compromise between futurism and old-fashioned woolwork, which is by no means beautiful. There is no equally startling needlework at Suffolk Street, nor any very wonderful craftsmanship, but the work there is interesting because none of it is of exactly the type which is at the present moment so popular in the Schools of Art, at any rate in London. There are several examples of appliqué work, including a piece of leather appliqué on a coarse canvas material by Miss Edith A. J. Wright, which, if not quite satisfactory, gives promise of good results later on, and some pretty little embroidered landscapes. The needlework versions of pictures by Romney and Sir Joshua Reynolds, again, are not conspicuously successful. That is hardly to be wondered at, for needlewomen who want to copy figurework are better advised when they seek their inspiration from the flatter and more conventional work of the earlier masters. Mrs. George Looseley's vellum-covered boxes, decorated with tooling and onlaid leather, are dainty and tasteful, though one feels that the fastenings ought to be rather better. On the whole, however, neither exhibition can be taken as representing the best that is being done by women in the field of the artistic crafts.

CORRESPONDENCE.

THE DECORATIVE TEXTILE INDUSTRIES AND THE DESIGNER'S RELATION THERETO.

I fear that this eternal warring of the "trade" with the "schools" in reference to textile designing is on a par with the quarrel which commercial men wage at intervals with elementary education. It would be convenient [for the business house] if the primary school, at the expense of the State, would turn out clerks meet for their prospective employers' service. But that is not the function of the primary school. So, also, the textile producer would have reason to rub his hands if, by simply going to the School of Art and holding up the alluring bait of £5 a week, he could get the perfect article which he required.

The State, however, cannot be expected thus to subsidise any branch of commerce or industry. The School of Art is not a textile factory, and the Art master has a score of other things to teach besides design. If the producer wants men well versed in all the ways of the producing machine let him train them himself, and if, when he has finished, he is satisfied, let him keep away from the School of Art altogether. His perpetual jibing at the schools arouses the suspicion that he cannot do without them. They can give his designers something which he and his workshop cannot, and he professes disgust that they do not also give that which he with his technical knowledge and facilities can and ought to give.

The student can get in the School of Art that instruction which, when supplemented by the practical training of the workshop, will result in his being efficient both practically and artistically. Just as the Art teacher trained in the schools is satisfied with a small salary until he has gained practical experience in teaching, so the design student would, I imagine, be satisfied with something less than £5 a week until he had acquired the technical finish to his artistic training of the Art School.

If the producing firms wish for schools which shall undertake both the artistic and technical branches of designing let them bear the cost or, at least, share it. Then certain schools, as centres for fixed areas, could be provided with the weaving and printing machinery necessary for the particular work, and the other schools, freed from constant criticism, could continue their excellent task of providing, in Mr. Eva's words, "a sound basis for all branches of Art."

R. E. GREEN.

OBITUARY.

WILLIAM WILLETT.—The death of Mr. William Willett took place on the 5th inst. at his residence in Chislehurst, at the age of fifty-eight. He was the head of the well-known firm of builders that bears his name, and is familiar to the public as the builder of some of the most beautiful houses in London. The reputation of the firm was first established by Mr. Willett's father, who only died in 1913, but it was greatly enhanced under the direction of the son, who was remarkable alike for his gifts as a builder and designer and as a business man. A large number of houses have been erected

by the firm, notably in the Kensington and South Hampstead districts, and they are usually remarkable for their artistic appearance and convenient planning.

Apart from his work as a builder, Mr. Willett's name was well-known in connection with his "Daylight Saving Bill."

Mr. Willett was elected a member of the Royal Society of Arts in 1893.

GENERAL NOTES.

Manufacture of Toys in Spain.—It has become apparent in Spain in recent years that the manufacture of toys can be made a lucrative industry on account of the steady demand, with the result that at present there are at least 400 Spanish manufacturers of importance supplying toys for domestic use and for export. The toy industry has made such pronounced progress that a national exhibition of toys was recently held in Barcelona, and it was largely patronised by the toy-makers in the neighbourhood, as well as throughout the Peninsula. Among the articles chiefly exhibited were turned wooden goods, including nine-pins, small furniture, besides croquet sets and wagons; metal goods, such as soldiers, small table services, trains, mechanical toys, guns, and pistols; paper goods, theatres with figures, marionette shows, and leather goods, comprising footballs and stuffed imitation animals, such as horses, donkeys, and dogs. The well-known brown bears are replaced by Spanish bulls. Special attention is given to the production of fine dolls of wax, papier-mâché, and china, many of which are dressed in national costumes. It may be noted, however, that highly-developed, self-propelled, and electrical toys are not much in evidence, and there appears to be a market in Spain for the introduction of articles of this kind of a good quality.

British Columbia Red Cedar.—British Columbia is regarded as the last stand of red cedar in North America, and it is predicted by lumbermen that within the next few years hundreds of new shingle mills will be established there to participate in the profits to be derived from the manufacture of cedar shingles, and that British Columbia will have almost the exclusive market of the continent for its red cedar lumber and shingles. Cedar logs and shingle bolts are not exported, except from Crown lands, and the prohibition will result in more mills coming to the province, as the product must be manufactured there. More than half of the shingles produced are exported to the United States, and as there still remains a plentiful supply of cedar timber in British Columbia, the industry promises to increase in importance and to become ultimately very profitable.

The Production of Geranium Oil.—The plant from whose stems the geranium oil of commerce is extracted was brought from South Africa to France about 1690. It was first cultivated on the Riviera, in the neighbourhood of Grasse, about 1847 for the production of geranium oil, and was introduced from France into Algeria about 1848. It is claimed that the quality of the geranium oil produced in the south of France is superior to that made elsewhere, but it can be produced more economically in Algeria. Owing to frost the plant has to be planted annually in France, and intensive cultivation, involving a considerable use of manure and watering, is necessary to secure an annual cutting. In Algeria the plant generally lives five to six years longer, and three annual cuttings can be made. Geranium oil produced in Spain is of good quality, and the geranium plant is cultivated in Valencia and Almeria. Owing to the economy of production, due to favourable climatic conditions, the most important producers of geranium oil at present are Algeria and the Island of Réunion. Geranium oil is a high-class perfume, but it has only a limited market, and prices have been affected by over production, and especially by the sale of cheap artificial perfumes. Geranium oils are liable to adulteration with fatty oils, and with the oils of turpentine and cedar-wood.

The Use of Cork Dust in Spanish Fruit Packing.—While a good deal of cork dust is used in the Province of Malaga and elsewhere in Spain, the city of Almeria consumes more of it than any other place in the country for its enormous exports of about 2,000,000 barrels of grapes per annum. Each barrel requires over 8 lbs. of cork dust, and each half barrel, of which usually only some 20,000 are exported, half as much. Altogether, including other fruit as well as grapes, about 12,000 tons of cork dust are used at Almeria alone, besides 200 tons in the Province of Malaga. As the quantity of dust made in Malaga is not sufficient for the requirements, large supplies are received in Almeria from Algeciras, San Roque, and other places in Andalusia, and from San Feliu de Guixols and elsewhere in Catalonia. Experiments are now being made on a large scale in shipping tomatoes, bananas, etc., from the Canary Islands packed in cork dust, and several consignments of dust for that purpose have lately been sent there from Malaga. The dust for the above purpose is cut finer than for grapes, for which it is ground a little smaller than grains of wheat. It is prepared for both uses by grinding the cork or cork trimmings between revolving stones, as in old-fashioned grain mills.

Weights and Measures Computor.—Mr. F. Seaton-Snowdon, of 22, Henrietta Street, W.C., has recently patented a "computor" which converts the value of goods offered in the currency and measures of one country in the correlative equivalent of the coinage and measures of another

country. The instrument closely resembles the familiar date indicator, and is equally simple in its manipulation, it being so arranged that by the mere movement of one of two handles the cost in pounds, shillings, and pence of an English lb., gallon or foot can be instantly and accurately read off in the equivalent units of any foreign measure of weight, capacity, or length, together with its value in the coinage of its country. The range of the instrument, as designed for use by those whose calculations have to be based on British coinage, is from ½*d.* to 10*s.* per lb., gallon or foot, but "spools" on which the figures are printed are in course of preparation, and will shortly be available for use by those who prefer to take as their value basis the currency of their own country. The "spools" are interchangeable, and a set of them can thus be used, as required, with the same instrument. The instrument is quite portable, the base being only some 3 ins. by 9 ins., and the price is 31*s.* 6*d.*

THE BRITISH ASSOCIATION.—The Council of the British Association, after consultation with the local executive committee at Manchester, has decided that the annual meeting of the Association shall take place in that city, as arranged, in September next. Both the committee and the Council have felt that it would be inexpedient, under present conditions, to offer the elaborate local hospitality, in the form of social and other arrangements, which has been extended to the Association on former occasions. The committee, however, expressed its desire that "the long continuity of the yearly meetings should not be broken," and stated that it would "prefer that the meeting should be held although restricted to its more purely scientific functions."

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock (except where otherwise announced):—

MARCH 17. — H. M. THORNTON, "The Industrial Uses of Coal Gas." SIR CORBET WOODALL, D.Sc., M.Inst.C.E., Governor of the Gas Light and Coke Company, will preside.

MARCH 24, at 5.30 p.m.* —LADY LUGARD, "The Work of the War Refugees' Committee." COLONEL SIR THOMAS H. HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Chairman of the Council, will preside.

APRIL 14. — T. THORNE BAKER, "The Industrial Uses of Radium."

APRIL 21.—MORETON FREWEN, "Profit and Loss in Our Sea Fisheries."

APRIL 28.—A. S. E. ACKERMANN, B.Sc., Assoc. M.Inst.C.E., "The Utilisation of Solar Energy."

* The hour of this meeting has been changed from 4.30 p.m. to 5.30 p.m.

MAY 5. — AUGUSTUS VERNON HARCOURT, D.C.L., LL.D., D.Sc., F.R.S., "On an Economical and Smokeless Grate, and on the Measurement of the Efficiency of Open Grates."

INDIAN SECTION.

Thursday afternoons:—

MARCH 18, at 4.30 p.m. —LIEUT.-COLONEL A. C. YATE, I.A. (retired), "The Indian Army." The RIGHT HON. VISCOUNT BRYCE, O.M., D.C.L., LL.D., F.R.S., will preside.

APRIL 15, at 5 p.m. — PERCEVAL LANDON, "Basra and the Shatt-ul-Arab." The RIGHT HON. EARL CURZON OF KEDLESTON, G.C.S.I., G.C.I.E., will preside.

MAY 13, at 4.30 p.m. —M. M. S. GUBBAY, I.C.S., "Indian Trade and the War."

COLONIAL SECTION.

Tuesday afternoon, at 4.30 o'clock:—

MAY 4.—S. CHAS. PHILLIPS, M.S.C.I., "The Empire's Resources in Paper-making Materials." The HON. SIR GEORGE H. PERLEY, K.C.M.G., Acting High Commissioner for Canada, will preside.

Dates to be hereafter announced:—

C. H. SHERRILL, "Ancient Stained Glass."

CHARLES R. DARLING, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

M. H. BAILLIE SCOTT, "House Building: Past and Present." Three Lectures.

Syllabus.

LECTURE I.—MARCH 15.—*House Building, Past and Present.* The nature of the building art—The modern conception of building and architecture—The utilitarian spirit in house building—The house necessarily a work of art, good or bad—As such has degenerated in modern times—The old house still the best—Architecture a dangerous term, and why—No art is degraded because it is useful—The fallacy of pure art—No pure art in nature—Art must cling to life and express itself in the service of life.

LECTURE II.—MARCH 22.—*Houses in the Past in this Country.* Three main periods: (1) The craftsman or mediæval period, when the art of building flourished; (2) The scholar, or Renaissance period, when the building art became "tongue-tied by authority"; (3) The shopkeeper, or commercial period—The distinguishing features of the three periods set forth as an allegory—The trades guilds—The spirit and methods of the old craftsmen—The scholar spirit—The commercial spirit.

LECTURE III. — MARCH 29. — *Houses of the Present.* The average house of the craftsman period adorned the world—The average modern house disfigures the world—Normal modern building a disease rather than an art—The causes and cure of this disease—Difficulties of the architect—Building by-laws—The qualities of various types of houses discussed—An ideal house described.

DAVID SOMMERVILLE, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.
April 26, May 3, 10, 17.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 15. ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. M. H. Baillie Scott, "House Building: Past and Present." (Lecture I.)

Victoria Institute, Central Hall, Westminster, S.W., 4.30 p.m. Dr. A. M. W. Downing, "The Determination of Easter Day."

Surveyors' Institution, 12, Great George-street, S.W., 7 p.m. Mr. A. J. Carpenter, "Some Points on the Insurance of Buildings against Fire."

British Architects, Royal Institute of, 9, Conduit-street, W., 8 p.m. Mr. J. Williams, "English Monuments."

TUESDAY, MARCH 16...Statistical Society, 9, Adelphi-terrace, W.C., 5.15 p.m. Mr. E. Crammond, "On the Cost of the War."

Illuminating Engineering Society, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Discussion on "The Marking and Rating of Lamps and the Best Methods of Specifying their Illuminating Value."

Royal Institution, Albemarle-street, W., 3 p.m. Professor Sir J. G. Frazer, "The Belief in Immortality among the Polynesians." (Lecture I.)

Engineers and Shipbuilders in Scotland, Institution of, 39, Elmbank-crescent, Glasgow, 8 p.m.

Photographic Society, 35, Russell-square, W.C., 8 p.m. Mr. R. B. Fishenden, "Machine Photogravure."

WEDNESDAY, MARCH 17...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. H. M. Thornton, "The Industrial Uses of Coal Gas."

Meteorological Society, at the Surveyors' Institution, Great George-street, S.W., 7.30 p.m. Dr. W. G. Duffield, "The Meteorology of the Sun."

Electrical Engineers, Institution of, Victoria-embankment, W.C., 7.45 p.m. (Students' Section.) Mr. W. H. Date, "Some Experiments on the Induction Generator."

(Local Section.) The University, Birmingham, 7.30 p.m. Mr. W. R. Cooper, "Electric Cooking, mainly from the Consumer's Point of View."

Microscopical Society, 20, Hanover square, W., 8 p.m. 1. Mr. E. J. Sheppard, "A New Mitotic Structure Disclosed as the Result of New Technique." 2. Mr. G. H. Wailes, "Notes on the Structure of Tests of Freshwater Rhizopoda."

Literature, Royal Society of, 20, Hanover-square, W., 5.15 p.m. Professor A. C. Benson, "George Gissing."

Mining and Metallurgy, Institution of, at the Geological Society, Burlington House, W., 8 p.m. Annual Meeting.

THURSDAY, MARCH 18...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4.30 p.m. (Indian Section.) Lieut.-Colonel A. C. Yate, "The Indian Army."

Petroleum Technologists, Institution of, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m.

Royal Society, Burlington House, W., 4.30 p.m.

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Linnean Society, Burlington House, W, 5 p.m. 1. Mr. W. M. Webb, "Hollow-shafted Feathers." 2. Messrs. J. A. Wheldon and W. G. Travis, "The Lichens of South Lancashire." 3. Mr. E. J. Bedford, "Coloured Drawings and Lantern-slides of Thirty-six British Orchids." 4. Dr. A. B. Rendle, "A Few Australian Plants."

Chemical Society, Burlington House, W., 8.30 p.m. 1. Mr. A. E. Dunstan, "The relation between viscosity and chemical constitution. Part IX.—The viscosity and fluidity of the aliphatic acids." 2. Messrs. J. C. Irvine, A. W. Fyfe, and T. P. Hogg "Methylated derivatives of a new form of glucose." 3. Mr. N. P. Campbell, "Velocity of crystallisation from aqueous solutions." 4. Messrs. A. Senier and R. B. Forster, "Studies in phototropy and thermotropy. Part VI.—Polymorphic vanillidenearylamines produced by trituration and by the influence of actinic light." 5. Messrs. J. A. Meads and F. S. Kipping, "Organic derivatives of silicon. Part XXIII.—Further experiments on the so-called siliconic acids."

Royal Institution, Albemarle-street, W., 3 p.m. Dr. A. Strahan, "The Form and Structure of the London Basin." (Lecture I.)

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mr. G. Lamley, "The Western Highlands."

Historical Society, 22, Russell-square, W.C., 5 p.m. Messrs. H. Jenkinson and H. Symonds, "Some Unpublished Privy Seal Docquets of the Civil War Time."

Concrete Institute, 296, Vauxhall Bridge-road, S.W., 7.30 p.m. Mr. O. C. Hills, "The London Building Acts: with Some Suggested Amendments."

Metals, Institute of, at the Institution of Mechanical Engineers, Storey's-gate, Westminster, 3 p.m. Annual Meeting. Reading of papers selected from following list:—1. Mr. J. H. Andrew, "Some Experiments upon Copper-Aluminium Alloys." 2. Mr. J. L. Haughton, "The Constitution of the Alloys of Copper with Tin." (Parts I. and II.) 3. Mr. O F. Hudson, "Etching Re-Agents and their Applications." 4. Professor A. K. Huntington, "The Effects of Heat and of Work on the Mechanical Properties of Metals." 5. Dr. G. H. Gulliver, "The Quantitative Effect of Rapid Cooling upon the Constitution of Binary Alloys." (Part III.—Conclusion.) 6. Professor A. A. Read and Mr. R. H. Greaves, "The Properties of Some Nickel-Aluminium and Copper-Nickel-Aluminium Alloys." 7. Dr. W. Rosenhain, "Some Appliances for Metallographic Research." 8. Mr. S. Whyte, "The Micro-Chemistry of Corrosion. Part III.—The Alloys of Copper and Zinc."

FRIDAY, MARCH 19...Metals, Institute of, at the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W., 10.30 a.m. to 1 p.m., and 3 p.m. to 5 p.m. Reading and discussion of papers continued.

Royal Institution, Albemarle-street, W., 9 p.m. Professor G. H. Bryan, "The Modern Piano Player—Scientific Aspects."

Mechanical Engineers, Institution of, Storey's-gate, Westminster, S.W., 8 p.m. Professors J. O. Arnold and A. A. Read, "The Chemical and Mechanical Relations of Iron, Cobalt, and Carbon."

SATURDAY, MARCH 20...Sanitary Institute, Exchange-buildings, Nottingham, 10 a.m. Discussion on "The Mothers' and Babies' Welcomes of Nottingham for Promoting Maternal and Infant Welfare."

Royal Institution, Albemarle-street, W., 3 p.m. Professor Sir J. J. Thomson, "Recent Researches on Atoms and Ions." (Lecture V.)

Journal of the Royal Society of Arts.

No. 3,252. VOL. LXIII.

FRIDAY, MARCH 19, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MARCH 22nd, 8 p.m. (Cantor Lecture.) M. H. BAILLIE SCOTT, "House Building: Past and Present." (Lecture II.)

WEDNESDAY, MARCH 24th, 5.30 p.m. (Ordinary Meeting.) LADY LUGARD, "The Work of the War Refugees' Committee." COLONEL SIR THOMAS H. HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Chairman of the Council, will preside.

Further particulars of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, March 15th, Mr. M. H. BAILLIE SCOTT delivered the first lecture of his course on "House Building: Past and Present."

The lectures will be published in the *Journal* during the summer recess.

INDIAN SECTION.

Thursday afternoon, March 18th; The RIGHT HON. VISCOUNT BRYCE, O.M., D.C.L., LL.D., F.R.S., in the chair. A paper on "The Indian Army" was read by LIEUT.-COLONEL A. C. YATE, I.A. (retired).

The paper and discussion will be published in a subsequent number of the *Journal*.

THE ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal of the Royal Society of Arts for 1915 early in May next, and they therefore invite members of the Society to forward to the Secretary on or before Saturday, March 27th, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit in promoting Arts, Manufactures, and Commerce," and has been awarded as follows in previous years:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S.

In 1865, to his Imperial Majesty, Napoleon III.

In 1866, to Michael Faraday, D.C.L., F.R.S.

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S.

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S.

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, etc.

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I.

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B.

In 1872, to Mr. (afterwards Sir) Henry Bessemer, F.R.S.

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., Member of the Institute of France.

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S.

In 1875, to Michel Chevalier.

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal.

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., Member of the Institute of France.

In 1878, to Sir Wm. G. Armstrong (afterwards Lord Armstrong), C.B., D.C.L., F.R.S.

In 1879, to Sir William Thomson (afterwards Lord Kelvin), O.M., LL.D., D.C.L., F.R.S.

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S.

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry in the University of Berlin.

In 1882, to Louis Pasteur, Member of the Institute of France, For. Memb. R.S.

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S.

In 1884, to Captain James Buchanan Eads.

In 1885, to Mr. (afterwards Sir) Henry Doulton.

In 1886, to Samuel Cunliffe Lister (afterwards Lord Masham).

In 1887, to HER MAJESTY QUEEN VICTORIA.

In 1888, to Professor Hermann Louis Helmholtz, For. Memb. R.S.

In 1889, to John Percy, LL.D., F.R.S.

In 1890, to Dr. (afterwards Sir) William Henry Perkin, F.R.S.

In 1891, to Sir Frederick Abel, Bart., G.C.V.O., K.C.B., D.C.L., D.Sc., F.R.S.

In 1892, to Thomas Alva Edison.

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S.

In 1894, to Sir Joseph (afterwards Lord) Lister, F.R.S.

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S.

In 1896, to Professor David Edward Hughes, F.R.S.

In 1897, to George James Symons, F.R.S.

In 1898, to Professor Robert Wilhelm Bunsen, M.D., For. Memb. R.S.

In 1899, to Sir William Crookes, O.M., F.R.S.

In 1900, to Henry Wilde, F.R.S.

In 1901, to His Majesty King Edward VII.

In 1902, to Professor Alexander Graham Bell.

In 1903, to Sir Charles Augustus Hartley, K.C.M.G.

In 1904, to Walter Crane.

In 1905, to Lord Rayleigh, O.M., D.C.L., Sc.D., F.R.S.

In 1906, to Sir Joseph Wilson Swan, M.A., D.Sc., F.R.S.

In 1907, to the Earl of Cromer, O.M., G.C.B., G.C.M.G., K.C.S.I., C.I.E.

In 1908, to Sir James Dewar, M.A., D.Sc., LL.D., F.R.S.

In 1909, to Sir Andrew Noble, K.C.B., D.Sc., D.C.L., F.R.S.

In 1910, to Madame Curie.

In 1911, to the Hon. Sir Charles Algernon Parsons, K.C.B., LL.D., D.Sc., F.R.S.

In 1912, to the Right Hon. Lord Strathcona and Mount Royal, G.C.M.G., G.C.V.O., LL.D., D.C.L., F.R.S.

In 1913, to His Majesty King George V.

In 1914, to Chevalier Guglielmo Marconi, G.C.V.O., LL.D., D.Sc.

A full list of the services for which the medals were awarded was given in the last number of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

A meeting of the Colonial Section was held on Tuesday, March 2nd, 1915; The Right Hon. Sir George H. Reid, G.C.M.G., D.C.L., K.C., High Commissioner for the Commonwealth of Australia, in the chair.

The Chairman, in opening the meeting, said he was often asked to do things, many of which he refused and many of which he accepted—the latter sometimes most reluctantly from a sense of duty, which was about the most painful malady that anyone could suffer from. But when he was asked to preside on the present occasion he accepted at once with the greatest possible pleasure, for a number of reasons, the two principal being that the subject to be dealt with was one of the most interesting within the whole ambit of the Empire, and, secondly, that the knowledge of the author was quite as large as his subject, which was not always the case. Mr. Lindsay was pre-eminently qualified to speak on the subject of the Northern Territory of Australia, as those present would appreciate after they had heard the paper.

The paper read was—

THE NORTHERN TERRITORY OF AUSTRALIA.

By David Lindsay,

Leader of the Elder Scientific Exploring Expedition.

That portion of Australia which is the subject of the paper I have the honour to read this afternoon is known as the Northern Territory of the Commonwealth of Australia.

It is nearly one-sixth of the whole continent. All expressions of opinion as to the characteristics of the country, its potentialities and its needs contained in this paper are the result of a personal professional study extending over more than thirty years.

My first visit to the Territory was in 1878. I spent six years in the coastal regions and over four years in the interior, surveying, exploring, prospecting and reporting on the country for the Government and private persons.

In 1913 I revisited the coastal regions as a member of the Royal Commission for the Northern Territory Railways and Ports.

The first attempt made to settle the north coast of Australia was in 1825, when a military post was established at Fort-Dundas, Melville Island. Owing to the hostility of the natives the settlement was in 1827 transferred to Raffles Bay on Coburg Peninsula on the mainland. In 1837 it was again moved, this time to Port Essington, which is a very fine harbour some thirty miles deep. In 1849 this was also abandoned, and those who had survived returned to England.

From 1827 to 1863 this Territory was part of the Province of New South Wales.

On July 25th, 1862, the great explorer, John McDouall Stuart, hoisted the Union Jack on the shores of Chamber's Bay, on the north coast, having, on this his third attempt, successfully crossed the continent from south to north.

The result of Stuart's report was the erection of the overland telegraph line from Adelaide

to Darwin, 1,896 miles by South Australia, at a cost of over £470,000, establishing telegraphic communication between Australia and England, and the dispatch of a party of surveyors under Colonel B. T. Finniss in 1864 to select a harbour and town site, and survey a large area of agricultural land which had already been sold to English and colonial speculators. Owing to adverse circumstances, bad management, and a wrong selection for the settlement, Finniss's expedition was a bad failure, and cost South Australia a large sum of money.

On December 27th, 1868, the Surveyor-General of South Australia, Mr. G. W. Goyder, sailed with a party of surveyors, and in a remarkably short time selected Darwin as the harbour, surveyed the town of Palmerston on the northern plateau overlooking one of the best harbours in Australia, and surveyed half a million acres which were sold at 3*s.* 9*d.* per acre, with a town lot given in with each 320 acres. No attempt was ever made by the purchasers to settle or develop this land.

In the eighties a railway was built from Darwin southwards—a length of 146 miles—to Pine Creek, to assist in opening up the mineral fields and as part of the transcontinental line. A southern section had already been built to Oodnadatta, 688 miles north from Adelaide.

South Australia, to which province this area of 523,620 square miles—extending from latitude 26° south to 11°, and from longitude 128° to 138°, the western boundary of Queensland—had been in 1864 provisionally annexed by Royal Letters Patent, had neither the surplus population nor the money to attempt the settlement of a land which was to its nearest point 800 miles from Adelaide, the seat of Government, and by sea to its northern harbour, Darwin, over 3,700 miles. All she could do was to throw open the lands on the easiest terms and conditions, establish experimental gardens to prove what could be grown, encourage mining, open up roads, keep a staff of officials, telegraph operators, surveyors, police, and magistrates under a Government Resident.

Truly this was an outpost of the Empire. When I went there in 1878 the mails were brought in Dutch steamers at intervals of ten weeks, the voyage from Adelaide taking twenty-eight days.

In 1871-72 gold was discovered, and a mining boom set in; large quantities of alluvial gold were obtained, and in face of almost insurmountable difficulties reef mining was attempted. Mining has since been continued under great difficulties of want of capital and suitable labour.

South Australia had conceived the bold project of building a railway 1,896 miles long, connecting Darwin with Adelaide, nearly due north and south. As previously stated, the southern section of 688 miles was built, when dry seasons and faint-hearted politicians caused this great work to be stopped at Oodnadatta, in the driest region of Australia, where the rainfall is only 5 ins. per annum. A gap of 1,070 miles still remains to be bridged.

Owing to the reported richness of the soil and the cheap land, various attempts were made to effect agricultural settlement by southern people. Sugar by De Lissa failed because of the unsuitability of the soil (for sugar will not grow on ironstone ridges) and ignorance on the part of the managers. Brandt, at Shoal Bay, failed for the same reason, although the soil on his selection was better. Ouston, on the Daly River, failed for want of capital. Coffee and rubber were planted at Beatrice Hills on the Adelaide River. These succeeded admirably, and proved the suitability of the climate and soil for both these valuable products, but labour difficulties, want of transport and capital, caused their cultivation to be abandoned. In spite of the neglect, and of the fires which every year sweep over the hills, coffee bushes still live and bear berries every year, and the rubber-trees attain great growth.

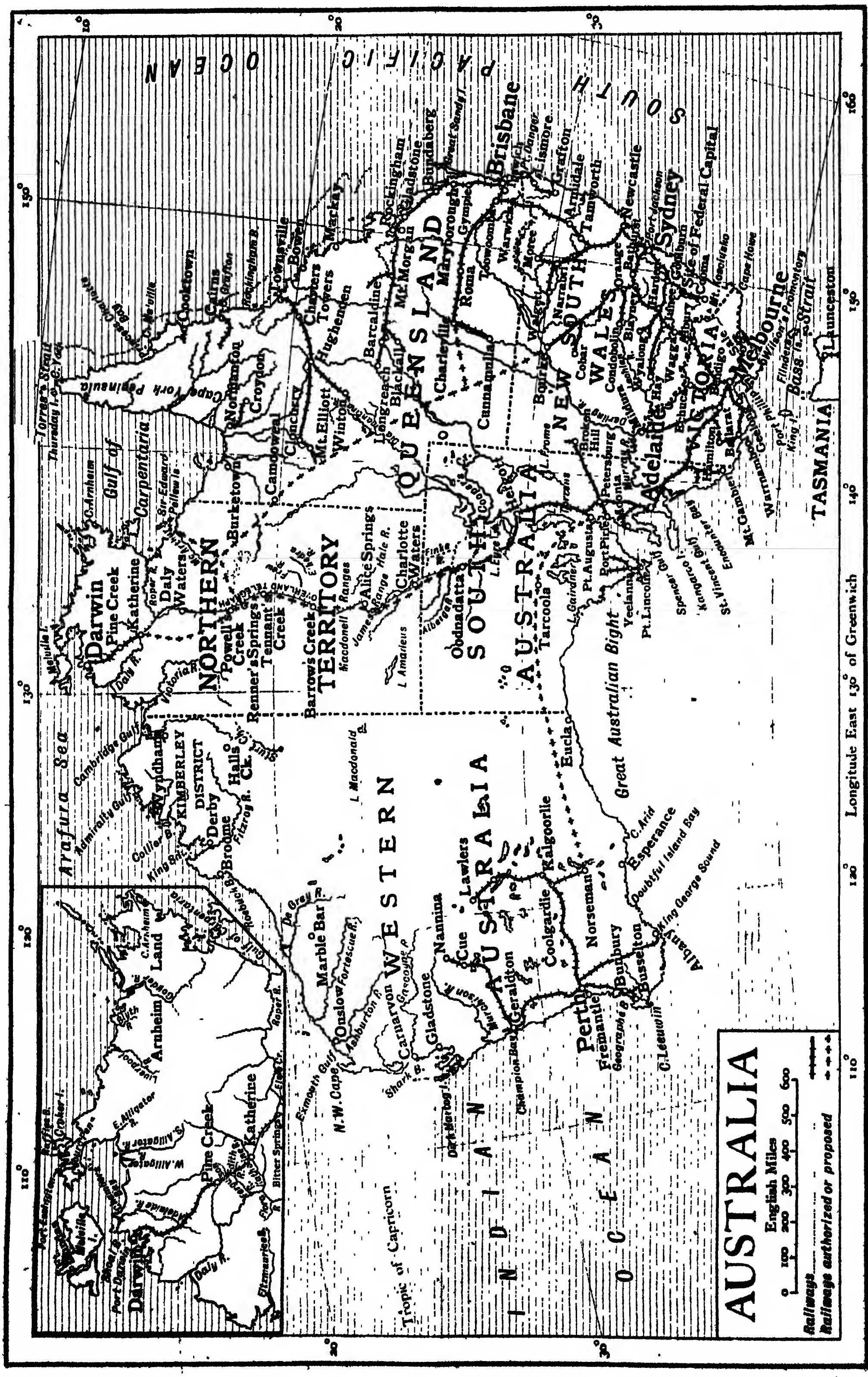
A Bill was passed through Parliament authorising the completion of the north-south railway on the land-grant system, but no businesslike attempts were made by the Government to introduce this to the notice of capitalists, and the opportunity lapsed.

When the States of Australia federated it was anticipated that the Commonwealth would take over South Australia's responsibilities and liabilities in respect to the Northern Territory, and administer and develop it. Pending this, South Australia agreed not to grant any leases or alienate any land; consequently the country made no advance for ten years.

On January 1st, 1911, the Territory was transferred to the Commonwealth under an agreement which set forth that a railway should be built connecting Darwin with Adelaide, such railway remaining within the boundaries of the Territory until it reached the southern boundary. Connections with the other States would follow.

Commonwealth Control.

In their haste to do something with this great lone land the Government of the day did not



NOTE.—The east-west line from Kalgoorlie to Port Augusta is in course of construction, and will be completed in two years.

consider what they had undertaken, but rushed into experiments.

An almost complete new staff of officers was appointed; "men with open minds and no preconceived ideas" were selected and sent up to enter at once upon certain works. Had they been given time to make themselves acquainted with a country whose conditions were quite different from anything these gentlemen had experienced, much money and some reputations would have been saved and blunders avoided.

The whole of the experience and knowledge gained by South Australia during the forty-five years she had controlled it, was turned down and treated as of no account. Consequently the past four years have not advanced settlement. Experimental farms and new conditions of land tenure have not induced many settlers to try their fortunes. Only eleven farmers have remained on their holdings.

An experimental sheep station has been established near the head-waters of the Roper River, and if success be obtained a large area of country, which at present is only considered fit for cattle, will be available for this class of stock.

A commencement has been made on the extension of the railway from Pine Creek to the Katherine River, a distance of fifty-four miles. This is a further link in the trans-continental line. Surveys and classification of lands are being vigorously carried on. A careful and systematic geological examination of the mineral areas is being made. Boring for water on the stock routes has commenced.

What of the Future?

The Royal Commission appointed to advise as to the routes of railways and new ports necessary for the development of the Territory recommended the connection of Pine Creek with Oodnadatta, as nearly as possible through the centre, a length of about 1,020 miles, thus connecting Darwin with Port Augusta and Adelaide, junctioning with the east-west trans-continental railway at Port Augusta; from a suitable point between 400 and 500 miles south of Darwin, a branch line south-easterly across the famed Barkly Tableland, to connect with the Queensland system, giving an almost direct line to Sydney, and, incidentally, all the Queensland ports; also a line about 250 miles in length from a new port to be created on the Gulf of Carpentaria, at the mouth of the McArthur River, up the valley of that river to link up with the Queensland-Darwin line. These lines would enable the whole of the Territory to be occupied, giving quick and easy access to the best ports. The total length is about 1,350 miles, and the estimated cost between seven and eight millions.

These recommendations will be given effect to, and then, and not till then, will the Territory have a chance of being settled and developed.

You will understand the isolation of this great country when I tell you that by sea Darwin is 3,700 miles from Adelaide, 3,200 miles from Melbourne, 2,620 miles from Sydney, 2,100 miles from Brisbane. It takes longer to journey from Darwin by sea to the nearest State capital than it does to go from Darwin to Singapore or Hong-Kong.

Should the traveller want to reach the great pastoral district from Melbourne, he would take steamer to Townsville, a distance of 1,800 miles; rail to Cloncurry, 480 miles; coach, 200 miles to Camooweal, which is just on the edge of the Territory, and then would find he was still 850 miles from Darwin. To reach the MacDonnell Ranges, he would travel by train 688 miles, and then by camels or horses 300 miles.

The Mining Industry.

The value of the output of minerals to date is over £2,000,000. In 1913, tin, valued at £25,526; gold, £13,256; copper, £482; wolfram, £3,140—a total of £44,626—were entered for export. Only ninety Europeans and 530 Chinese are engaged on the fields.

It is of the utmost importance that this industry be fostered and encouraged in every way. Mining gives great promise of responding profitably to fair and liberal treatment. Making roads, laying light lines of railway, erection of public batteries, subsidies for deep sinking, and large rewards for the discovery of payable mines will induce prospectors and capitalists to embark on this enterprise. It is necessary that all this assistance be controlled by an energetic and competent mining department, which I think the Territory has just now.

Mining attracts population quickly, and it has to be fed; thus a local market for the produce of the agriculturist is provided, enabling him to dispose of vegetables, fruit, rice, horsefeed (maize and lucerne), tobacco, milk, butter, and eggs, besides giving the small grazier a market for his fat stock.

Pastoral.

This industry has been established in various districts where there are natural permanent surface waters, and although the profits have

been small, owing to the great distance from the markets and the consequent low price obtainable for stock on the stations, the flocks and herds of sheep and cattle have increased year by year, until there are now over 450,000 cattle, 20,000 horses, 75,000 sheep, 8,000 goats, depasturing on the 107,406 square miles leased, which brings in the insignificant amount of £10,109 as rent. The rental for pastoral leases is very low indeed, ranging from 6*d*. to 4*s*. per square mile.

With the advent of higher prices for meat created by the overseas demand, the station holders will be enabled to improve their holdings, and depasture many times the number they now do. Increased rents will be obtainable.

The opening of stock routes by providing water, the building of railways, and the opening of a new port, as mentioned before, will open up a country capable of carrying 30,000,000 sheep and hundreds of thousands of cattle, turning a practically unoccupied country into one of the most important suppliers of meat to Britain.

The inland regions are remarkably healthy for stock, which have but few diseases, and, notably in the southern portion, no better or hardier horses can be found in Australia. Some of the journeys made are marvellous, showing the sustaining qualities of the natural grasses. I once rode a small horse—"a well bred 'un"—120 miles in twenty-four hours. Cattle grow large, and the meat is excellent; the wool from the sheep is first-class.

Agriculture.

With the building of railways and other public works, the establishment of the mining industry, a certain amount of coastal agriculture will be profitable. Until there is a local demand it is sheer folly to induce farmers to attempt the growth of the many things that can be grown easily. Agriculture cannot pay the high wages for clearing and cultivating now obtaining.

The Australian ideal of a White Australia prevents the employment of a cheap, suitable indentured labour that otherwise could be used for the growth of cotton, sugar, rice, tobacco, Sisal hemp and other fibres, etc., for which we know the climate and soil are suitable.

It will be seen that the problem of labour is a difficult one that has to be faced.

Mining can afford high wages; stock-breeding does not require much labour and can pay ruling rates. Agriculture must have cheaper labour than Australia can supply. Our standard of living is too high. We must, therefore, seek a people from a country which has a lower standard. Where are these to be obtained? After this great war it seems to me that few countries will have any surplus labour, with the exception of Spain, to which many thousands of its people are returning from South America, where they cannot obtain employment. These men would make good navvies for our new railways, and could afterwards, with their families, be settled on the land in colonies. The country would produce nearly everything they need. Houses are cheaply constructed, and clothes required are few and cheap.

There is one product that may change the whole aspect, and that is wheat. The Australian understands wheat-growing, and likes it because it does not entail hard and continuous work the year round. The cheapness of the land would induce a rush of farmers once they were convinced that wheat could be grown. Experiments with Indian wheat have in a small way been decidedly successful; but it is necessary that demonstrations on a large scale be made, and it is difficult to understand why the Commonwealth, encouraged by what South Australia had recently done, has not during the past three years experimented and settled the question.

If wheat could be grown on the uplands, many of the products of the low-lying 50,000,000 acres of coastal lands would be needed for the wheat farmer. Hence the great importance of testing the wheat-growing capabilities of the country.

The late Mr. Holtze, Curator of the Gardens, stated, after fully experimenting with upland rice, that it was a great success, and would be to the Territory what wheat was to South Australia. Like wheat, rice can be garnered with the aid of machinery.

Cotton, with suitable labour, would be profitable.

The Northern Territory is 900 miles long, 560 miles wide, and has a seaboard of over 1,200 miles, indented with numerous spacious harbours and intersected by many large navigable rivers.

It has an area of 335,116,800 acres. It is two and a half times the size of France, four and a half times the size of the United Kingdom, with a rainfall of 6 ins. on the southern boundary, gradually increasing as one goes north till it is 60 ins. at Darwin.

This vast country is practically unoccupied,

the total population being 3,588, of which 2,143 are Europeans, and mostly employed by the Government in Darwin and its neighbourhood.

The exports are gold, silver, copper, lead, wolfram, tin, fish, pearl-shell, trepang, cattle, horses, sheep, and buffalo-hides.

It is estimated that there are between 20,000 and 30,000 aboriginals roaming about this vast land.

CLIMATE.

The climate on the coast is hot and humid, but not nearly so bad as in similar latitudes north of the Equator. There is nothing to prevent white races living and thriving, and I do not believe they will degenerate physically; indeed, it is surprisingly healthy, so much so that the medical officer claims it to be superior to other portions of Australia. It is true that the death-rate per 1,000 is the lowest, but then we have no crowded cities, and the people lead open-air lives. There are men who for the past thirty to thirty-five years have worked hard, lived hard, and never been away for holidays.

The inland plateau has a drier climate, the rainfall being so much less; and it is absolutely a white man's country.

The wet season extends from October to April, and the dry or winter from May to September, during which period nothing more than a few drops of rain ever fall—in fact, the skies are cloudless both day and night.

South of lat. 17° winter rains do fall, but in no great quantities—sufficient to keep the grasses fresh. The winter is most bracing and healthy, except on the coast when it is the fever season, caused by chills, caught in many cases through insufficient bedclothes, the temperature falling to 56°, and the maximum being 89°.

At the head of the Roper and further south it often falls below freezing-point. In the MacDonnell Ranges I have recorded 18° or 14° below freezing-point.

The maximum shade temperature on the coast or tropical portion in the wet season is 96°, and the minimum during the night 65°.

6,800	square miles	have a	rainfall	under 10 in.
213,480	,,	,,	,,	from 10 to 20 in.
96,790	,,	,,	,,	,, 20 to 30 in.
120,600	,,	,,	,,	,, 30 to 40 in.
86,500	,,	,,	,,	over 40 in.

CLASSIFICATION.

Coastal country, 75,000,000 acres, well watered, good soil along creeks and rivers, tropical vegetation and coarse grasses, parts metal bearing and probably coal bearing.

Eighty million acres, good pastoral country, often rich volcanic soil, well grassed basalt, sandstone, and limestone hills, wide plains and river flats, and first-class pastoral country, open, well grassed, rich soil.

Eighty-seven million acres, fair to good pastoral country, leaving about 90,000,000 acres of spinifex scrub and sandhill country, with patches of inferior pastoral country, badly watered, and uncertain rainfall. Parts metal bearing.

I will now take you, illustrated by pictures, many of them from photographs taken by myself, for a rapid run through the country, commencing at the southern boundary.

From Oodnadatta, the terminus of the railway, the traveller passes over fair pasture-land, high stony tableland, intersected by large sandy creek beds which contain fine water-holes. To the east is a remarkable group of springs—hot, cold, and mud—the Dalhousie Springs. The tableland is scantily clothed with grass, edible shrubs and bushes, and although it has a rainfall of only 5 ins., cattle and horses are bred and fatten, and ofttimes top the markets. At 808 miles from Adelaide Charlotte Waters telegraph station is passed, and on crossing the boundary line one is struck by the sudden change from open stony tableland to a country where trees, grass, and bush are growing in profusion, and the morning air is filled with the songs of many birds, a marvellous change of scene, giving promise of fairer lands as the rainfall increases the further north we travel.

Along the Coghlan Creek there is rich pasture-land, salt and cotton bush, grasses and herbs of many descriptions. Water of the finest quality can be obtained at shallow depths. We are still within the great artesian basin, which a few miles to the east has been tapped at a depth of 1,250 ft. in the Anacoora bore, yielding 700,000 gallons in twenty-four hours.

Onwards through mulga scrubs—an edible bush—open plains, high sandhills, and stony rises for ninety miles, having crossed the large sandy rivers, the Goyder, Finke, and Hugh, all of which send their flood-waters to that great sink, Lake Eyre, in South Australia, a salt lake over 200 miles long, lying 15 ft. below sea-level.

After crossing fair pastoral country for 200 miles, the remarkable MacDonnell Ranges are met with. Away to the south-east is a region of about 10,000 square miles of high sandhills,

which might almost be termed a desert, but for the fact that it is clothed more or less with bushes, and water can be obtained by sinking. It is intensely hot. I once crossed it in the middle of summer when the thermometer registered 127° in the shade. I and my companions were two days without water in this intense heat. To the south-west the country is sandy, but there are some good freshwater springs, and it is fair stock country, with several prosperous cattle-men stationed there, who breed cattle and horses, the latter of great stamina and bone. Adelaide is the market.

After crossing the James Range the high sandhills are left behind, and the country is decidedly better—undulating plains, slightly stony, and intersected by numerous watercourses, and hills richly grassed. There are several permanent springs and abundance of water obtainable at shallow depths. This good country has a width of about 150 miles east and west. The rainfall has now increased to 11 ins., and at 989 miles the saddle of the MacDonnell Ranges is crossed at an elevation of 2,500 ft. above sea-level, the highest point on the road from Adelaide to Darwin.

The southern barrier of the MacDonnell Ranges is of a most remarkable character, as it rises out of the plains to a height of 1,000 ft. or more, like a wall through which, at intervals of six or eight miles, a fissure or opening has been made, out of which a creek emerges on to the level plains. This range extends east and west, and the openings are called gaps—Temple Bar, Emily Gap, Jessie Gap, Heavitree Gap, through which the north-south railway must be built, there being no other practical route through these ranges.

The rock is of red quartzite, dipping at very steep angles, and resting on gneissic granite. Passing through these gaps, low ranges of granite and metamorphic rocks are found, which gradually rise till on the saddle the height is 2,500 ft., and the great inland plateau is entered upon.

The MacDonnell Ranges lie south of latitude 23°, and are about sixty miles wide, stretching eastwards 150 miles, and westwards nearly 200 miles. They attain their greatest elevation and their most steep and rugged forms of development in the neighbourhood of Alice Springs. The central mountain from which flow the creeks which drain that region is called Bald Hill; it is between 3,500 and 4,000 ft. high. The range splits up into branches from this locality, trending east and west like the fingers of a hand, and having distinctive names, with about 20 mountains, none of whose elevations is less than 3,000 ft., and some over 4,000 ft.—one is said to be 5,000 ft. high. Mount Brassey, which I named after Lord Brassey, is 1,800 ft. above the valley at its base. Between these ranges are luxuriantly grassed valleys, making an ideal stock country. Water is obtainable at shallow depths in the creek channels.

A most remarkable gorge near the eastern end of the ranges, which I named after my wife, Glen Annie, through which the Hale River passes, is the largest of the fissures referred to. It cuts through a quartz anticlinal, forming a fissure only 10 to 15 yds. wide in places, with precipitous walls 400 to 600 ft. high. It has a length of five miles, and sometimes widens out to 3 chains. It is absolutely impassable for horses or camels. There are permanent waters in it on which the sun never shines.

The Arltunga goldfield is situated about forty-five miles from Alice Springs, and has yielded a fair quantity of alluvial and reef gold worked under the most primitive conditions. From the White Range, which is an immense auriferous quartzite ridge, the richer parts are broken down and carried in tin dishes on the heads of aboriginal women to the valley, bagged and conveyed on camels to the small battery a few miles distant.

Immense areas of these ranges are metalliferous, gold, silver, lead, copper, and mica; but until the railway passes through, the difficulties of transport and the cost of all mining requisites are too great to allow of any extension of the mining industry. The general geological structure is metamorphic and plutonic primary rocks.

Camels bear a very important part in the settlement and development of the drier regions of Australia—in Queensland, New South Wales, West Australia, and this Territory. They carry on an average 5 cwt. each, and travel fifteen miles a day, and can go for long periods without water. On one of my exploring expeditions, when I had a party of fourteen and forty-two camels, heavily loaded, we crossed the Great Victoria desert, accomplishing the marvellous feat of traversing 550 miles in thirty-five days, each camel during that period having had only 7½ gallons of water—only one died. The camel is a fine beast for riding, and, as you will notice, we sit in quite a different position from that usual in Egypt. I once rode a camel 480 miles in seven days.

The aboriginal inhabitants of the Territory

are black in colour; in the southern and central divisions they are few in number, but of fine physique. In the coastal region there are, it is estimated, over 20,000, most of them roaming about at will within the limits of the tribal divisions; a few employed on the stations, and numbers hanging about the mining camps and settlements. Without them the white women of the territory would have a hard time, as white domestic servants are almost unobtainable.

The natives are nomadic in their habits; they have no settled place of abode, no permanent houses or shelters, and wear no clothes; they subsist on game and certain vegetable roots, seeds and fruits.

I hold rather a high opinion of the latent possibilities in these people, and believe that if they were taken in hand properly, and kept free from the contamination of European and Oriental civilisation, a fine body of agricultural labourers could be evolved, perhaps setting at rest the embarrassing question of how to get labour for the tropical regions. We know they are expert in the use of tools, they have been taught to build houses, to make galvanized-iron water tanks. Their original manufacture of canoes, strong rope baskets, fish-nets, shows their intelligence and cleverness.

I submitted a scheme to the Commonwealth Government, suggesting that Melville Island, which contains about one and a half million acres, and on which some 15,000 buffaloes are running wild, at present being shot for the hides only, be set apart as a reservation, and all the natives gradually removed there, and, under capable men, trained as agriculturists, etc. This scheme was not approved by the responsible officers, who, though eminently scientific and authorities on the habits and customs, have, I may be pardoned for saying, not the practical knowledge to qualify them to express a decided opinion on a scheme of this kind. It cannot be denied that this Australian native has never had a chance. Mission stations, while doing good work, are naturally limited in their spheres, and cannot control the natives, who can go and come as they please; while on an island, with the unlimited powers and resources of the Government, the natives could never get out of control. Melville Island therefore offers a unique opportunity to demonstrate whether the native can be civilised and preserved, or whether he must simply die out; and Australia would at least be able to say: "We have tried to save the people whose land we have taken," and remove a stigma from our records.

To return to our travels. On the plateau, after crossing the saddle of the MacDonnell Ranges, we are in a fine pastoral country with a good soil, which should be suitable for the growth of cereals. The climate is good and the rainfall is increasing. Under modern conditions of railway management, the distance of 800 miles to Port Augusta is not too great for the economic transport of grain.

The northern route leads over very easy country, with a slight fall for 110 miles, where the elevation is 1,490 ft. In the next thirty miles there is a rise of 230 ft.; twenty miles further a rise of 30 ft., until we again find ourselves 1,756 ft. above sea-level. Then a declining elevation becomes constant right to the coast. At Barrows Creek telegraph station the height is 1,724 ft. The country passed over for the last 100 miles has been somewhat mixed, some of it being fair, while a good deal of poor sandy country is met with. To the westward are ranges with good valleys and a lot of poor spinifex areas, but all capable of carrying some stock. We have also crossed two large belts of metalliferous country, in which gold has been found, promising when the railway passes along to develop into several mining fields. The poor country one sees impresses one unduly, for it would be hard to convince the traveller on a hot summer day that within a day's ride there is a land of great beauty and value. Some forty miles off the road, after crossing Spinifex, sand-plains, and hills, we find good country. Riding along the valley of the Spence, on either bank grow large trees confusing in their variety, luxuriant grasses, wild flowers and delicate ferns; on our right, about a quarter of a mile away, running parallel with the creek, is a high range of hills rising abruptly, with white lime trees and vegetation growing to the very tops, and flowering creepers overspreading the rocks. After passing through several gorges of great beauty we cross the dividing range. It is here that the Frew River commences. We rode for thirty-five miles along the Frew, which was running, passing several large sheets of water. Birds were very numerous. Twenty-five miles below the station is a lake some two miles long. Wild-fowl of every sort were on its bosom, while on its banks we saw pigeons, kangaroo, and emu. The grass and foliage, rich and luxuriant, are made green with running rivers and gracious with temperate air. Still further on is the Elkedra River, the valley of which is almost as

ich in herbage as the Frew. We found Mitchell grass, silver grass, kangaroo grass, blue grass, mulga grass, barley grass, salt bush, blue bush, mulga, herbage, and various creepers and runners; altogether a rich and beautiful country, making it hard to realise that we were 1,300 miles from Adelaide, and in what was supposed to be desert country.

To Powell's Creek, at 1,431 miles, we passed over alternately good and poor country, with a rainfall of 15 ins. to 18 ins. Thirty miles before reaching Powell's Creek there are some fine ever-flowing springs—Helens and Renners—surrounded by a large extent of exceedingly fine and well-grassed country. The geological formation indicates the possibility of artesian water being obtained by boring.

Away to the eastward for 350 miles, right to the Queensland border, stretches a magnificent pastoral country, consisting of downs and plains clothed with Australia's best grasses —Mitchell, blue, and Flanders. Barkly Tableland occupies a part of this region, which is capable of carrying 10,000,000 sheep, and when a railway is built to the proposed new port at the McArthur River, sheep will take the place of cattle.

To the westward lies the great pastoral district known as the Victoria River district, a fine, well-watered area clothed with Mitchell and other good grasses and edible bushes. The area is about 40,000,000 acres, with a certain rainfall of 20 ins. to 30 ins. The development of a large portion is being undertaken by English capitalists, who have bought the stock and leases, and are erecting freezing works at Darwin to enable the meat to be shipped to England. South of this district is good sheep country, unoccupied because there are no natural waters.

From Powell's Creek northwards the country is nearly level and well grassed, but not good enough to enable the traveller to imagine the magnificent country lying to the west and to the east.

Daly Waters telegraph station, at 1,591 miles, is typical of the telegraph stations. A dead tree in front of the building still shows the large "S" cut in by a member of Stuart's party in 1862, and which is held in great reverence by bushmen. The soil is good, the grasses good; stock doing remarkably well, especially horses, but there is no permanent surface water, though water can be got by sinking.

A lot of sandy, open forest country with inferior grasses is passed during the ninety miles to the Elsie. Yet with water it is all able to carry stock, and might grow wheat; the sandy loam, with a rainfall of about 25 ins., warrants a trial being made. It is a high, dry land with a fine climate. The Elsie is one of the heads of the Roper River, and has rich soil and luxuriant grasses in its valley. Limestone is the prevailing rock. Thirteen miles further takes us to Bitter Springs, really the source of the Roper River. Here are many springs bursting up through the white limestone, and flowing in strong streams into the main channel. The water is slightly saline, contains also magnesia and lime, but is palatable and fit for domestic use. Just here the experimental sheep station has been formed. Some 20,000 acres of rich black soil fit to grow anything surround the springs. Maize and such-like fodder could be grown quite easily. Seventy miles over a lot of poor country brings us to the Katherine River. Although the bulk of the country for fifty miles as seen from the road is poor, there are large areas of what look like fine wheat lands stretching away on either hand. The soil is rich reddish loam, and the grass grows about 3 ft. to 4 ft. high and thick, and level as a crop of wheat. Forty miles before reaching the Katherine we pass a promising mineral belt, recently discovered, in which rich tin ore is being mined. The Katherine may be considered the outer fringe of the tropical or coastal belt. The soil is good, suitable for agriculture, well watered; and here again wheat should be tried. The rainfall is 40 ins.

Onwards to Darwin the road leads through a metalliferous area, consequently the country is poor, except in patches along the creeks and rivers; and it is owing to what is seen from the road that some travellers have condemned the Territory in their ignorance, not knowing that rich and extensive plains are to be found on the rivers to the right and left. The country away from the hills may be described as level, open forest, good soil of a light nature, and, judging from the luxuriant growth of grass and trees, must be suitable for agriculture.

Rivers.

To the westward, about fifty miles, is the mouth of the Daly River, which is navigable for light-draught vessels for about sixty miles, where there is an extensive belt of rich soil, on which the agricultural settlement is being established. There are some good copper deposits, not now being worked. The river drains a vast area of country, and the enormous floods that sweep down during the rain season make navigation both difficult and dangerous.

The Katherine, which heads from the sandstone tableland some 250 miles inland, flowing through a volcanic area, joins the Daly; so, too, the Edith, the Fergusson, Cullen, and many of the creeks of the mineral belt. There are some hot springs. The Flora, coming from the south, is an ever-flowing stream of great volume, in which is a fine fall, which may be used as a power-producer and for irrigating a large area of extremely rich agricultural land in the vicinity.

When the time and conditions are ripe, irrigation will be easily applied to make agriculture in the coastal regions a sure, safe, and profitable occupation. I know of no country where the waters can be more easily and cheaply used for irrigation.

Further west is the Fitzmaurice, about which little is known.

The Victoria River, near the West Australian border, appears, on looking at the map, and has been described as the most important river in the Territory; but later information somewhat discounts this idea. The mouth or entrance is twenty-six miles wide, and the navigation is dangerous, being obstructed by shifting sandbanks and ever-changing channels. It is, like the Daly, subject to bores. With these difficulties overcome, it would be the outlet for the great rich district surrounding its headwaters, and would be navigable for large vessels for fifty miles, and by suitable shallow-draught boats for a further sixty miles.

Eastwards from Darwin, forty-five miles, the mouth of the Adelaide River is passed. This river is tidal and navigable for vessels drawing 13 ft. for over sixty miles, winding its tortuous way through magnificently grassed plains, more or less subject to inundation, suitable for agricultural and pastoral pursuits. It is a most magnificent rice country, equal to the best in Saigon; with suitable labour conditions, a large population could be settled here. Many buffalo roam at will over these vast plains. It is near the head of navigation where the coffee and rubber plantations were established, and only failed through want of labour and transport facilities.

A squatter here has proved the great suitability of the country for successful and profitable pig-raising.

The next rivers of importance are the West, South, and East Alligators. Our steamer anchored twelve miles inside East Alligator, and we proceeded in a launch for fifty miles further. The river is tidal and deep, and could easily be made the channel for conveying the produce of an extensive area of rich country.

The vast plains, extending as far as the eye can reach, clothed with a dense growth of grass, more or less subject to inundation during the wet season, are the home of the buffalo, which are the progeny of half a dozen turned loose when the settlement at Port Essington was abandoned. They increased so rapidly that over 100,000 have been shot for their hides alone, providing good incomes to the shooters. It seems a great waste that such fine animals should be killed merely for their hides, and their carcasses thrown aside. I see no reason why, under proper management, the breeding of these animals could not be made a profitable and permanent industry. The hides are easily tanned and valuable, the meat yields a dark rich extract, the bones and offal could be turned into manures. At present the carcasses remain where the animals are shot, only providing food for the natives employed by the hunters.

Near the head of this river, and at the foot of the sandstone tableland, which attains a height of 1,800 ft., is an aboriginal reserve under the control of a man of long experience—one of the most noted buffalo shooters. He speaks most hopefully of the natives, who do all the work of the station, building houses, yards, huts, cutting and carrying timber, clearing scrub and cultivating the ground. In the garden grow most luxuriantly cabbages, carrots, beetroot, lettuce, beans, cucumbers, celery, sweet potatoes, English potatoes, tomatoes, pumpkins, melons, peanuts, maize, pawpaws, bananas, citrus fruits, mangoes, custard-apples, pineapples, almonds, tobacco, millet, cotton, and Sisal hemp.

The next point of importance touched was Port Essington, where the military post was established in 1839. As we entered the harbour we were signalled by a lugger; the master—a trepang and pearl-shell fisher—reported that a white man had been killed by the natives some 100 miles to the eastward. It is a curious coincidence, and an evidence of the little change that has taken place in the conditions of life on this lonely coast during the past thirty years, that when I visited this place thirty-two years ago it was with a party of police, who were searching for natives who had killed a white man on Croker Island.

Steaming along this interesting coast-line amongst beautiful isles, we passed the Liverpool River, on which is some good country, the Blyth, and the Goyder, which is the most important river flowing into the north coast from

Arnheim Land. I explored this in 1883, and found much good land and numerous very hostile natives, who attacked my small party several times.

The Goyder flows for forty miles through fine, richly grassed, black and red soil plains. No finer soil can be found in the Territory, or even in Queensland. Yet, owing to the labour question, there is no settlement of any kind; the country is quite unoccupied except by the natives.

For over two hundred years the Malays came to this coast every year for trepang and pearl-shell; they founded no settlements, but evidence of their visits is found amongst the natives and trees and plants from their island homes.

There are some fine well-sheltered deep-water harbours along this coast, until we round Cape Arnheim and head south 200 miles to the Roper, which is the best known river, as it was used for the conveyance of the material for the construction of the overland telegraph line for a distance of eighty miles from its mouth, where vessels of 1,500 tons burden discharged cargo.

The Roper heads from the same sandstone plateau as the Katherine, one flowing east, the other west, and drains a large area; consequently the flood-waters are heavy, and the silting up of the channel at the mouth is considerable. At the entrance there is a bar of sand and mud, the depth of water at low tide being 7 ft.; the rise and fall of tide is 7 ft. After crossing the bar there is deep water, in places 60 ft.; for twenty-five miles beyond that 8 ft. at low water over certain bars and shoals. The river is tidal, and is a very fine waterway, many of the long reaches being over half a mile wide.

From the head of navigation, where the fresh water falls over a rocky bar (the flow of water is so great that the water on the river is fresh enough to drink within forty miles of the mouth), the valley, bounded by high and picturesque ranges and mountains, extends for 100 miles to the telegraph line, embracing some large areas of good soil and some fine pastoral country. The river has several channels and deep holes, ten and more miles long, shaded with magnificent timbers. This valley will in the future carry a fairly large population, and then the river will be largely used.

It has been stated by some of the recently appointed officials that the Roper can, by locking, be made navigable right up to the telegraph line, 160 miles. This is not possible, as the fall in this distance is 425 ft.

The river that is destined to play the most important part in the development of the Territory is undoubtedly the McArthur, which flows into the Gulf of Carpentaria, 110 miles south of the Roper. Off the mouth of this river lies a group of islands—the Sir Edward Pellew Islands—which contains a very fine deep-water harbour and safe anchorage, being completely landlocked.

It is proposed to connect this harbour with the mainland by a railway, crossing several islands and the intervening channels, and the various salt-water channels forming the delta of the river. Until proper and complete surveys and tests have been made, it is not known whether this will be too costly or not. In the meantime it is proposed to establish a shipping place inside the mouth of the river, where there is a very suitable site for a town and wharves.

The railway would start from this point and follow the valley of the river through good country for 150 miles to the great pastoral plateau and junction with the main lines, as explained earlier. This port is the natural outlet for over 200,000 square miles of pastoral, agricultural, and mineral country, capable of supporting a large population, and carrying over 10,000,000 sheep and one and a half million cattle besides horses. The Commonwealth Government is seized with the importance of this outlet, and I shall not be surprised if this is the next railway built in the Territory.

I look forward with confidence to the time when this port will rival in size and importance Townsville in Queensland, as it is easier of access and controls a much larger area, without the possibility of opposition from any other port. A large extent of good agricultural land could be irrigated and brought under lucerne. The rainfall is 28 ins., and the climate is healthy, and probably the most agreeable of any port in tropical Australia. It has the advantage of being within the artesian area, flowing water having been struck at 415 ft. by boring.

One cannot speak too highly of the country to be served; no better grazing country exists than the Barkly Tableland, which is from 600 to 900 ft. above sea-level, and is being rapidly improved and stocked with cattle and sheep—already there are 200,000 head of cattle and 70,000 sheep. In the not distant future the McArthur River must be the port of shipment for frozen meat in large quantities.

To Summarise.

Briefly put, the Northern Territory has magnificent harbours and rivers. It abounds in minerals; there are millions of acres of rich agricultural land awaiting development. There are vast stretches of uplands clothed with Australia's best grasses, capable of supporting millions of cattle, sheep and horses, only needing railways and the facilities for getting produce to markets, and the introduction of capital and suitable labour. Men and money are all that is needed to add a prosperous new State to the Commonwealth.

It is within ten days' steam of the great Asiatic markets, and a week nearer to the European markets than is Sydney or Melbourne, and any of my hearers who may be tempted to invest money or go there will find it full of possibilities which will readily respond to proper treatment, and they need have no doubts about the climate.

DISCUSSION.

The Chairman (Sir George H. Reid), in opening the discussion, said he had been intensely interested in the paper, which possessed the invaluable attribute of being written by a man who had been there, a very great advantage compared with most of the addresses that were heard in London. The Northern Territory was one of the remaining tough propositions which Australia had to solve; but fifty, sixty, or seventy years ago many places in Australia which were now the scenes of prosperous industry did not look a bit better than Northern Australia did at the present time. In the early days Australia was thought to be an almost universal desert, and it was one of the marvels of the Commonwealth that, as years had gone by, the "desert area" had been so wonderfully lessened. Labour questions in the Northern Territory would, of course, have to be considered. There were so many more attractive places in Australia for comfort and luxury and everything else that everyone ran after, and which everybody thought no one else should run after, that the Northern Territory was greatly handicapped; but that it would become one of the most important parts of Australia he had not the slightest doubt. He remembered in his young days in New South Wales that old colonists told him wheat could not be grown in districts like Wellington, and that they did not know what could be profitably done with them; nevertheless they were among the richest districts in Australia at the present time. The possibilities of the pastoral industry in the Northern Territory were immense, and it was necessary to bear in mind that in the history of every part of the world the pastoral industry was the safest and best foundation for future development. That was so in the times of Abraham, and it was just as true at present. As the pastoral industry developed, a mixed sort of industry, of agriculture with pasture, arose. That very simple law to begin with, the development of the great pastoral possibilities, which did not require any statesmanship but only a slight knowledge of the way in which communities grow, should be applied to the Northern Territory, because it was the very best foundation that could be adopted. It was there that the wealth of the Northern Territory was most visible, and when those industries had been fully developed it would be astounding how easy it would be to make further advances. The author was one of a noble band of pioneers and explorers, whose names ought not to be forgotten.

Lieut.-Colonel the Hon. Sir James Newton Moore, K.C.M.G. (Agent-General for Western Australia), in proposing a vote of thanks to the author for his interesting paper, said it was essential in connection with the development of any new country to profit by what had happened in the development of other countries, and it was therefore necessary to bear in mind, in connection with the development of the Northern Territory, that the pioneer of all industry, as the Chairman had stated, was the pastoral industry. Before, however, the pastoralist appeared upon the scene, pioneer surveyors and explorers like the author had to open the way for him, and then the miner and the prospector followed. The Commonwealth authorities would have seriously to consider what they should do to encourage the prospector in the Northern Territory, and in that respect they had the advantage of the experience of what Western Australia had done in this direction. After the pastoralist and the miner became established the agriculturist came along, but the agriculturist had rather a stiff proposition so far as the Northern Territory was concerned. If the experiments that the author had suggested in that connection were carried out, it would undoubtedly be to the benefit of all concerned. He was not altogether in accord with what the author had said in regard to the question of native labour, probably because he had not had Mr. Lindsay's experience. In Western Australia an endeavour had been made to give the natives a chance by the Government purchasing a station and giving them an opportunity of running it for the purpose of seeing whether it was possible for them to work out their own salvation. As an old surveyor he desired to express his very great appreciation of the work the author had accomplished. In 1892 he (Sir James) was a youngster in the survey department of Western Australia, and about fifty miles due east of Coolgardie he came across what was known as the Slate Well. There were no signs of human habitation, but he discovered some fresh tracks of camels there, and in a little tree he found an empty bottle of Lea & Perrin's Worcester sauce with Lindsay's name on it. That was twenty-

three years ago, and up to within a few days of the present meeting he had never had the opportunity of shaking hands with the owner of that bottle of Worcester sauce. He would not guarantee that it contained Worcester sauce, but it was a Lea & Perrin's bottle, and if the author and his party, as he had stated, only had seven and a half gallons of water in fourteen days he would probably be glad of a drink of something a little stronger.

The Right Hon. Sir William MacGregor, G.C.M.G. (late Governor of Queensland), said that to him the most interesting question connected with the Northern Territory of Australia was the relation between that land and mankind, whether with respect to the white man or the coloured man. He gathered the author inferred that it was quite possible for the white man to live and work in Northern Australia. He (Sir William) had seen a great many men working hard and well in that Territory, but that did not by any means settle the question whether Northern Australia was inhabitable by a white race. Not very long ago Dr. Breinl, the medical officer in charge of the School of Tropical Medicine that had been erected on the east coast of Queensland, told him he had been asked by the Commonwealth Government to give an opinion on the question, and he sought some advice as to the answer he should give. He advised Dr. Breinl to say that it was a question that could not be answered until at least four generations had lived in the north. The white woman had not any coloured assistants to help her in her household duties, and he was sure all the ladies present would sympathise with a white woman who had to live in a house built principally of galvanised iron, and who had to do the cooking, the washing, the ironing, and look after her husband and her children. He had never hesitated to point out to politicians on the other side of the globe that that was at present the weak point with respect to the peopling of Northern Australia with a white race. Woman had not received that consideration which she deserved, and must receive, in connection with that great question, if a white race was to people the northern part of the continent. The author had mentioned the fine physical proportions of some of the native races, and he had noted that fact himself. There were on Mornington Island, in Queensland, natives that were still living in their original primitive condition. He visited them about two and a half years ago, and, according to the report of the protector of the aboriginals there, he was the first white man that had ever seen their women and children. They were a very fine race. He found that on many of the stations in the far north-west, on the Barkly Downs, for example, many natives were employed as stockmen, and received as high wages as the white stockmen. He visited all the native camps, going from Winton over to the Northern Territory, up the Georgina and down the Gregory, and across the Gulf of Carpentaria, and found that whereas there would be as a rule fifty or sixty men and women in a camp, there were only about three or four children. It was a most unfortunate thing that the race was dying out; in two or three generations, at the present rate, the native race would be practically extinct. The mission that was likely to succeed best in the Northern Territory was the one at Mapoon. That mission had adopted the principle of keeping the natives about the mission for a certain length of time, then putting them out on the land and assisting them for twelve months in building houses, and also by giving them seeds and plants, and at the end of that time they were left entirely to their own resources. When he visited the mission he found the natives were growing vegetables and fruit, and marketing them in Thursday Island. One of the inevitable difficulties in connection with peopling the Northern Territory of Australia with a white race was the heat of the sun, and there were two points in that connection that it was hard to get rid of, the first being the physical and chemical results of exposure to the sun's rays, and the other the diseases that were peculiar to such a climate. So far as Queensland was concerned, he did not know of any other country that was equally healthy for both man and beast. Very few diseases existed, and of those some were more or less new to the medical faculty; hence the foundation of the newly-erected School of Tropical Medicine at Townsville. That would enable them to deal with such things as the disease due to the hook-worm, which had been mentioned in many papers in this country during the last two or three years. There were a few diseases connected with stock which urgently required investigation, but he knew of no country that was as healthy as Queensland, taking it all round. So far as the mere heat of the sun was concerned, it would be of interest to state that for three or four consecutive days he had experienced a temperature that measured as high as 118° F., but he had never heard of a single man or woman who had a headache from it, whereas if such temperatures occurred in Africa, where he lived for a number of years, he did not know how many corpses there would have been as the result. With regard to the question of the desert, not very long ago he had the honour of conducting Lord Bryce over a considerable portion of Queensland, and showing him some of the best agricultural and horticultural country, and Lord Bryce could hardly credit the statement when he assured him that there was no such thing as a desert in Queensland. The capabilities of that great continent were extraordinary. The Barkly Downs comprised a great area of country which was equal to anything he knew. It seemed to have a bed-rock of a sort of silicate limestone, which had been hollowed out here and there by the action of rainwater and the carbonic acid of the air dissolving out the lime, so that there were numerous great holes and cavities in the earth, into which the overflow of the rivers went to supply, probably to a very considerable extent, the water in the artesian

wells. There was as much water over that great area of the Barkly Downs as people liked to raise, and if the country were in the hands of the Chinese it would support at least four or five million people on the Barkly Downs alone. The country was so level that, although people could travel 120 to 130 miles a day on a motor-car, very often the horizon was bounded by the natural curve of the earth. As a result, the vegetation that grew and decayed was left on the spot; the country was so level that it was not washed away. The Flinders grass, which, in other parts of Queensland was about six or nine inches long, was 15 and 18 inches high along the Barkly Downs, and the Mitchell grass and the blue grass were growing in the finest profusion. The future of the country was certainly going to be enormous. One of the maps that had been shown gave an outline of the railways that were being laid down by the Government of Queensland to open up and develop the country. There were at the present time in Queensland between 600,000 and 700,000 horses, between 5,000,000 and 6,000,000 cattle, and about 22,000,000 sheep, and it was estimated that when the network of railways now in hand was completed those figures would be doubled.

The Hon. J. G. Jenkins (formerly Premier of South Australia), in seconding the motion, said that for a good many years he was Minister for the Northern Territory, and had the opportunity of presenting the finances of that Territory to the House in order to get them to vote a large deficit every year. He could fully endorse most of the remarks the author had made. It was often said that parts of Australia were a desert. He had been at Oodnadatta when it would have been impossible to find a blade of grass after searching over miles of country; but a few months later, after there had been two inches of rain, he had found grass a foot and eighteen inches high on the same ground. The man who had called the district a desert was there before the rain came; he should have gone after the rain, and then he would have corrected his statements. People had sometimes asked why the Arltunga goldfields in the MacDonnell ranges had not been further developed. As the Minister who had charge of the erection of the cyanide plant, he found that it cost from £28 to £30 per ton to cart the material from the head of the railway at Oodnadatta—which was 688 miles from Adelaide—for the 200 miles past the Alice Springs country. It would be easily appreciated that it was impossible to make mining pay if so much money had to be spent on the carting of the necessary material. Many of those present would remember Mr. Buchanan, of "Killarney," New South Wales, who was a very large landholder in both Western Australia and the Northern Territory. A few years ago Mr. Buchanan arranged with a Mr. Lewis to drive a thousand head of cattle right across the heart of Australia, from the Victoria River to Hergott Springs. Mr. Lewis carried out the work with a loss of less than thirty head of cattle, and animals that were worth £2 a head on the Victoria River brought £7 10s. to £8 a head at Hergott Springs when sold by auction. That showed the possibilities of the country so far as the cattle industry was concerned, and at the same time proved that Australia was not a desert.

The Chairman, before putting the resolution of thanks, said he desired to tell the audience a story which proved that all camels were not so reliable as those to which the author had referred. On one occasion a man with a camel came into Kalgoorlie from a distant spot in the interior. He met an old friend, who asked him to have a drink. He declined the invitation, but said that if his friend would give his camel a drink he did not mind. The ostler was thereupon told to give the camel a drink, for which £1 12s. had subsequently to be paid!

The resolution of thanks was then put and carried unanimously.

Mr. David Lindsay, after thanking the audience most heartily for the vote of thanks that had been accorded to him, said he would very much have liked, if time had permitted, to discuss more in detail the questions of the heat, natives and labour, that had been dealt with by Sir William MacGregor. Those three questions were so vitally bound up with the future of the Northern part of Australia that they were worthy of the study of the best scientific men. Personally he was born amongst the natives and lived amongst them; he knew them from one end of Australia to another, and therefore knew what he was talking about when he said that the West Australian native must not be compared with the Northern Territory native. Nor was it quite possible to compare the Queensland native with the Northern Territory native, who was a far higher being, much more intelligent, and capable of being made great use of. Native carpenters were employed in the building of the houses at Port Darwin, and he had seen a native go into a blacksmith's smithy, make a bolt, put a screw on it, make the nut, and everything requisite for the purpose. The natives also went into the forest, cut down the timber, brought it back, and erected houses with it. Such men ought not to be neglected and allowed to die out, but they would be so long as they were allowed to hang about the settlements. It was the so-called civilisation of the white man that was killing the native, and if the suggestion he had made, that was turned down so contemptuously, had been tried, even if it had cost Australia £25,000, it would have been nothing to the advantage gained by preserving probably 20,000 people who would be capable of supplying the labour necessary for the development of the north coast.

THE RIGHT HON. THE EARL OF KINTORE, G.C.M.G., writes:—I am greatly obliged to you for affording me the privilege of seeing a proof of the paper on "The Northern Territory of Australia" which Mr. David Lindsay is to read on Tuesday next. No living authority on that Territory, its needs and possibilities, is greater than the author's, and I am confident that his hearers will appreciate in some degree the exertion and hardships Mr. Lindsay underwent to possess himself of knowledge of which his paper is but a digest, and that they will be helped to realise the immensity of this great lone land, a land which, given railway communication, access to markets, water and labour, will be waiting for development and settlement. Up to now the Territory has never had a chance. Provisionally annexed to South Australia in 1864, it came later to be known as South Australia's white elephant. Herself sorely in need of population and capital, South Australia had nothing to spare for the huge territory annexed to her. What little she could do was done, but that the resulting benefit was small cannot surprise us, seeing that this dependency's development was in the hands of a Parliament sitting some 2,000 miles distant, and composed of members who were either wholly ignorant of, or largely antagonistic to, established and successful methods of development of sub-tropical countries elsewhere. Mr. Lindsay sets out the very promising prospect the Territory shows for horses, cattle, sheep, agriculture, and mining, and he points to the reasons why, so far, more has not been done. It only required a short visit to convince me of their accuracy. On my return to Adelaide, overland from Darwin, in 1891, I urged strongly that the Territory should be taken over by the Commonwealth Government so soon as it came into being, and that through railway communication between Darwin and Adelaide should be established. The Territory was taken over by the Commonwealth some four years ago, and it is satisfactory to know that active steps are being taken to bridge the gap of at least 1,000 miles between the existing railway termini. I remember how it was contended that this through route would materially shorten the time of transit for the oversea mails and passengers, but if through traffic is sought I much doubt whether it will be obtained if the gauge of the rails is not broad and the train-speed high. However, in any case this railway, and others which I am delighted to know are seriously projected, will do much to relieve the want of transport and the difficulty of access to markets. It is also most satisfactory to know that an energetic and competent mining department now exists to assist and encourage the mining industry, for it is a mere truism to say that the Territory's important mineral fields should support a population infinitely larger than 90 Europeans and some 500 Chinese! It is well established that the extensive alluvial areas on the rivers and coasts can grow sugar, rice, cotton, hemp, and other products, to support such a population; but until effective labour at rates which agriculture can afford to pay, and which Australia to-day cannot provide, can be found, I fear these valuable tracts will remain undeveloped. Perhaps something can be done with Latins from Spain or South America, as Mr. Lindsay suggests, but I more than doubt whether Australians of the temperate zones will ever be able to put in effective, continuous and remunerative work for their employers in the tropical climate of the Territory's coastal districts. Be that as it may, I cannot doubt that this difficult problem of labour must be solved by-and-bye, and the present drawback to agricultural development removed. Capital and population will follow, and the erstwhile white elephant of South Australia will come to be regarded as one of the most valued assets of the great Commonwealth, and its pioneers held in grateful remembrance. One last word. Among those pioneers, I hope, may be counted those who at Port Essington during the years from 1837 to 1849 endured much, and I trust steps may already have been taken for the due and reverent care of the ground where many officers and men are sleeping their last sleep. In my time the place was overrun with rank grasses and bush, while the lettering on the headstones was becoming overgrown and undecipherable. For the sake of the dead, and for their living descendants, we must all hope this neglect has been remedied. I greatly regret that absence from London will prevent me hearing Mr. Lindsay's paper, and from joining, by word of mouth, in the congratulations his Chairman, Sir George Reid, will receive on the occurrence of the anniversary of his birthday.

MR. LINDSAY writes:—The effect of working under the tropical conditions obtaining in the coastal districts of North Australia upon future generations is as yet unknown. No one can express a decided opinion. The second generation born there do not yet show any signs of degeneration, and when communication with the southern temperate regions is made easy and cheap, enabling the mothers and children to get away for occasional changes, I am sanguine of the future. I must confess I do not think that white men can retain their vigour, working in the sugar-cane fields and inhaling a miasmatic vapour, with a tropical sun blazing down on their backs. At present the domestic servant problem is an obstacle to white women settling and making permanent homes. I am much indebted to the Right Hon. Lord Kintore for his very appreciative letter and notes on my paper. The ideas expressed are those of one who has travelled right across the continent from north to south, and who spent some time on the coast. The expression of his views on the necessity for coloured labour caused considerable comment; but it was recognised that Lord Kintore's report was a valuable addition to the knowledge of the Northern Territory. Lord Kintore will be glad to know that the tombstones and memorials to the early settlers at Port Essington have been restored —I think by the generosity of someone in England.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 17th, 1915; David Milne Watson in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Hitchins, Alfred Bishop, 194, Main-street, Binghamton, New York, U.S.A.

Maxwell of Calderwood, Lady (Jane), Glen Owen, Cheltenham.

The following candidates were balloted for and duly elected Fellows of the Society:—

Misra, Gadadhar Prasad, 193/2, Harrison-road, Calcutta, India.

Park, Kendall, 50 Calle Ballester, San Gervasio, Barcelona, Spain.

The paper read was—

THE USES OF COAL GAS FOR INDUSTRIAL PURPOSES.

By H. M. Thornton, J.P., M.I.Mech.E.

In this historic lecture theatre, many of our scientists and scholars, and protagonists in the economic work and advances of this country, indeed of the world, have sent forth new messages and made new advocacy, and have contributed to the history of material progress.

Unlike some of those, I have to-night no new message to give you; but I have my story to tell—a story that has an interest not only for every industry in the work of which there is application of heat, but for every individual who has progress at heart, and whose desire is the improvement of our social conditions by the promotion of a more salutary atmospheric environment, and for every individual who sees in the suppression of waste and the substitution of economy fresh turns of the wheel of civilisation. The Royal Society of Arts has given a wealth of encouragement to all who have such stories to tell. Its records bear testimony to the work of those who have spent time in urging and fostering the improvement of the atmosphere of our towns and cities. A great deal has, from time to time, been said as to the existence of the insanitary conditions of that atmosphere. Computations have been frequently made by eminent authorities, guided by analyses of the air of towns—especially manufacturing ones—and by measurements of the soot and ash deposits, as to the degree of pollution that takes place under the local circumstances. We accept these computations without much question, because those of us who are of a less scientific turn of mind, but whose work is of that practical nature which is complementary to the work of the scientist, daily see the visible and outward signs—despite Acts of Parliament and the ordinance against the emission of "black" smoke. The important thing is to find an effective remedy, and in this direction I would express the hope that the Departmental Committee on Smoke Abatement (whose work has been interrupted by the war) will be able, through their report, to indicate practicable means for bringing about a material abatement, if not, as we hope, the complete abolition of the smoke curse, and so advance a much overdue reform in the daily conditions of town life.

Crude Heating Methods and the Destruction of Valuable Necessaries.

There are, to make a general division, two main sources of atmospheric pollution—the industrial chimney and the domestic chimney. With the latter I have not this evening anything to do. In the lectures delivered before your Society in the spring of 1913, Mr. F. W. Goodenough dealt with the domestic phase of the problem, and showed how heating for all domestic purposes could be obtained through the agency of gas—or, in some cases, coke—economically, without dust, without pollution, and with the maximum of efficiency. It is the industrial chimney with which we are concerned this evening, and the displacement of crude heating by a refinement which not only disestablishes the chimney as a polluter of the atmosphere, but introduces into the factory itself a controllable and uniform system of heating, producing constancy of result, and adding materially to industrial economy by the reduction of labour, the promotion of cleanliness, and the speeding-up and improvement of factory output.

These aspects of the case for industrial heating constitute the main part of my remarks this evening; but let me for a few minutes—without going largely into statistics—explain the great destruction of value for which crude methods of heating in our factories are responsible. Mr. Edward G. Hiller, in a paper on "Power Production in the United Kingdom," read before the Manchester Association of Engineers in January, 1914, supplied data showing approximately the quantity of coal consumed in the United Kingdom for various purposes during 1911; and it may be taken that they generally

agree with other calculations that have been made.

Factories	used 66	million tons
Householders	„ 84·3	„ „
Iron and steel industries	„ 32·1	„ „
Mines	„ 20·5	„ „
Gasworks	„ 15·4	„ „
Railways	„ 12·8	„ „
Potteries, etc.	„ 5·7	„ „
Coasting steamers	„ 2·4	„ „
Total	189·2	„ „

Now if we remove from this table only one item which bears upon the subject I have in hand this evening, we see that factories alone consume 66 million tons of coal a year, or just over one-third of the total.

What does this mean in the way of wastage? Supposing the 66 million tons of coal were carbonised in the retorts of our gasworks, and yielded an average of 12,500 cubic feet of gas per ton, we should have from it a total production of 825,000 million cubic feet of gas, which, on the new Parliamentary standard of 540 B.Th.U. per cubic foot, would be equal to 445 billion B.Th.U. It is impossible properly to grasp what such figures mean, but those billions of B.Th.U. are B.Th.U. that are in industrial heating controllable, and there is comparatively little waste in obtaining from them effective duty. With coal there is a large amount of waste of heat units in effecting its combustion, and in driving off those volatile constituents which are useless where high temperatures and pure incandescence are required, and must be obtained. There is also waste of heat units up the chimney shaft, and through stand-by requirements. There is waste of heat units every time a fire is re-charged until once more favourable working conditions of the fire are realised. With gaseous fuel—whether using high or low pressure, or low pressure with air-blast—the heat can be directed exactly as needed into the furnace or on to the crucible where required; and heat losses by radiation and otherwise can be largely prevented by proper construction and insulation.

Pursuing the point as to waste, we have our gas as the primary product. There are the secondary ones. First, there is coke. Carbonise the 66 million tons of coal in gas retorts, we should have for sale—deducting a reasonable amount for carbonising fuel—between 10 and 11 cwt. of coke per ton of coal, which would give a total of (say) 35 million tons of smokeless fuel for the market, with a calorific value of (say) 13,000 to 14,000 B.Th.U. per lb. = over 1,000 billion B.Th.U. in the aggregate. Then, according to the system of carbonisation, and the composition of the coal, we should produce some 10 to 11 gallons of tar per ton of coal carbonised; and so some 700 million gallons of tar would be realised. In addition to this, given good working—using a retort-carbonising system in which there is not a large destruction of ammonia, and with ordinary care in preventing waste of ammonia—there would be produced about 28 lbs. of sulphate of ammonia per ton of coal carbonised, or 825,000 tons of a valuable fertiliser.

These figures demonstrate the amount of waste that is taking place by such a large use of coal in our factories. I do not for one moment assert that the calculated data I have given would be realised from the whole of the classes of coal used in factories, but an equal weight of gas-making coals would give in valuable products approximately the returns which I have presented to you. Nor do I say that the whole of that coal could be displaced. But an exceedingly large part of it undoubtedly could be; and other industries of the country would be served by the provision of larger supplies of the materials to which I have referred that are required to meet, especially since the war began, the ever-expanding demands of our population and of the world.

Take tar, for instance. Apart from its value for the production of large quantities of oils of various grades, of beautiful aniline dyes, and of indispensable chemical products, its use has largely grown in recent years for road surfacing and road making. With the home extension of the aniline dye industry to supplant the huge German export of aniline dyes and colours to this country, tar, as the source from which the intermediate products are secured from which the dyes are made, will be required in considerably larger proportion. From tar, too, motor spirit (benzol) among much else is recovered. According to the quality of the coal used, the system of carbonisation employed, and whether the gas is washed for its recovery, from 1 to 3 gallons of benzol can be obtained from different coals per ton carbonised. The importance of the avoidance of the waste of the valuable necessaries resident in coal is accentuated by the war. Only recently the Army Council notified producers of tar that they require to have placed at their disposal all their production of toluol or substances containing it—such as commercial benzol, light oils, or solvent

naphtha—while interfering as little as possible with existing contracts. When it is remembered that 90 per cent. benzol produced from tar from Durham coal contains about 70 per cent. of benzene, 25 per cent. of toluene, the remainder being light hydrocarbons, etc., the importance of tar to the Committee on High Explosives and to the nation and its Allies at the present time (and for all time, for our protection and the satisfying of our wants) is self-evident. The toluene, I may add, is used for the making of trinitrotoluol: and as emphasising the waste that goes on, through the crude use of coal, the War Office are now making arrangements with our large gas undertakings for the washing of their gas for the extraction of the toluene from it. From the gas product of a ton of coal (say, 12,000 cubic feet), according to the coal used and the system of carbonisation employed, from 2 lbs. up to probably in cases 5 lbs. to 6 lbs. of pure toluene will be obtained. Assuming only 2 lbs., this amount will make 4 lbs. of trinitrotoluol. (*Journal of Gas Lighting*, February 16th and 23rd.)

Dawn of a New Era in Industrial Heating.

I have thus far trespassed upon your patience n showing that, in addition to air pollution, industry is largely wasting, by its crude methods of heating, parts of the substance of the country which are necessary—more necessary to-day than they have hitherto been, though always valuable since their discovery. I believe I have successfully shown that, for economic reasons, the coal cast under the boilers of the factory or stoked into the heating furnaces, results in a wastage wholly appalling. The question naturally arises: Is it practically possible to do away with the waste? Admittedly custom in industry is a difficult thing to eradicate. Manufacturers, however, are beginning to look upon these matters from a more enlightened point of view than of old. In the mechanical handling in our industrial works, science has long since won way; but it has made made way at slower rate in regard to the heating operations, whether it be for melting, annealing, hardening, or otherwise. Experience of the new methods—experience satisfactory in every way—is also having weight. In fact, much has already been done in supplanting crude methods of heating by the refinement of gas processes; but that much, my intimate knowledge of possibilities permits me to say, represents only the dawn of a new era in industrial heating.

The Manufacturer's Point of View.

The manufacturer has his point of view in this matter; and we have to adopt, in order to secure his examination of the question from other points of view, the art of "gentle persuasion," though not the "gentle persuasion" practised by the man on strike. So far we have considered the benefit to the community; but here, as in arguing the case for coal smoke abatement, it is necessary to show to the manufacturer that it is not only to the benefit of the community, but to his direct benefit as a manufacturer, to adopt the modern smokeless method of firing. Some of the advantages are:—

(1) Economy in space occupied by appliance; necessity, and expense in some cases, of smoke-stack eliminated; a practically unlimited choice of position for the furnace, which enables it to be brought into close proximity to the machine workers.

(2) No space required for storage of fuel, and no removal of ashes.

(3) Increase in output per cubic foot of factory, owing to economy of space occupied by gas-furnaces in comparison with hard-fuel furnaces.

(4) The constant and unvarying supply of fuel of a uniform calorific value, at a fixed rate.

(5) Labour saving—absence of stoking, storage and conveyance of fuel.

(6) Rapidity and improved production, due to ability precisely to control correct working temperatures.

(7) In many cases a lower capital expenditure of installation.

(8) Cleanliness, which frequently is of primary importance where furnaces have to be introduced into machine-shops, or in close proximity to machines.

As a concrete example of the foregoing advantages, I would like to quote the experience of a large firm of spring-makers. They recently installed seven gas-furnaces in substitution for hard-fuel furnaces, and their testimony is highly interesting. Summarising it:—

(1) They save two-thirds of their floor space.

(2) They save labour to the extent of dispensing with one stoker

(3) They secure absolute reliability and uniformity of temperature, which is highly essential in spring-making.

(4) They entirely eliminate smoke and soot in their workshops.

(5) Their fuel bill for coal-fired furnaces was for one year £694; the gas consumption for executing the same work was the next year

£425—showing a saving in fuel alone of £269 per annum.

In view of these advantages, it is not surprising to learn that this firm decided to abandon solid fuel entirely; and they now do the whole of their work with gas-furnaces—their consumption of gas being nearly 8 million cubic feet per annum.

As another example, the following figures, obtained from a firm manufacturing chronometers and nautical instruments, are highly convincing:—

(1) They previously used steam for power, and coke for brass and gun-metal melting furnaces, at a cost of £135 per annum for fuel.

(2) They now use a gas-engine and gas crucible furnaces; and their gas bill is £105 per annum, showing a clear saving of £30 per annum.

(3) In addition to this, they now secure an average number of six melts per day, as against four with coke-furnaces; and therefore, supplementing a saving of 22 per cent., they have increased their output by 50 per cent.

Having briefly enumerated the national advantages to be obtained by the use of gas for industrial purposes, and also shown how the manufacturer himself may benefit, I will now, by illustration and brief description, show what an important part gas is already playing in the advancement of some of our largest industries, which gives us encouragement to hope that the ideals expressed in the commencement of this paper may one day be realised.

DEPOSING THE COAL-FIRED STEAM-BOILER.

Our attention must be first directed to the primary requirement of most manufacturing establishments, viz., the creation of power. The old coal-fired steam-boiler still exists in numerous factories; but steadily the gas-engine is superseding it wherever its application is possible. Fig. 1 shows part of the engine-rooms of the Richmond Gas Stove and Meter Co., Ltd., at Warrington. The power for these works, which employ over 1,000 men, is entirely obtained by gas, amounting approximately to 500 h.p.

FIG. 1.—PART OF ENGINE-ROOMS OF THE RICHMOND GAS STOVE AND METER COMPANY, LIMITED, WARRINGTON.

In some factories where power is used intermittently, electric motors applied to each individual machine are found more convenient than driving by shafting from a central power source. In such cases gas-engines are very frequently and advantageously employed for the generating of the current required. Fig. 2 shows a very large installation of 2,700 b.h.p. gas-engines for generating electricity at the Crystal Palace.

The Bonecourt gas-boiler provides means for steam-raising, and for this purpose is being increasingly used.

I have, with brevity, shown that the first essential for a works requiring power can be provided by gas, whether by means of gas-engines or by the process of steam-raising, also by means of gas. Having established this point, and before passing on to review the numerous furnace applications for town gas, I should like briefly to mention also the very extended field offered for the use of gas coke for heating large muffle or oven furnaces. As before stated, this great by-product of carbonisation in gas-making, offers an excellent smokeless fuel, which Continental manufacturers use much more freely than we do. When it is used in a modern furnace we are indeed employing this coke to produce our desired gaseous fuel and thereby following the dictates of efficiency, of economy, and cleanliness.

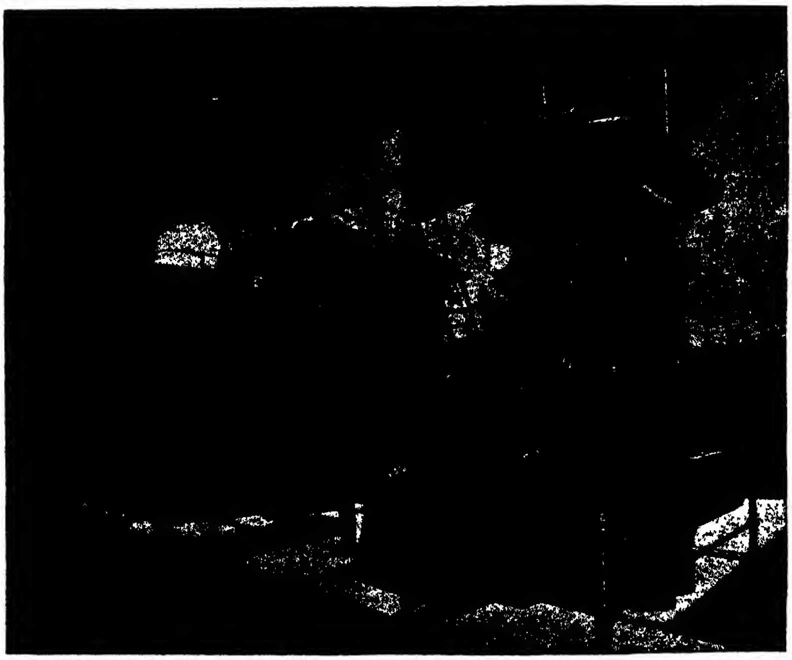


FIG. 2.—2,700 B.H.P. GAS-ENGINES FOR GENERATING ELECTRICITY AT THE CRYSTAL PALACE.

REPRESENTATIVE FURNACES.

In the first place, it will, I think, be interesting to describe briefly some of the chief points of the principal types of furnaces.

From the Laboratory to the Works.

Gas-heated muffle and crucible furnaces, and so forth, are not new. They have been used in the laboratory for experimental purposes for many years. But those laboratory appliances did not take count of the relation of fuel consumption and of time expenditure to work done, as is necessary in industrial operation. The most that was required of them was the attainment of given temperatures for special work. To translate the old laboratory furnace and crucible equipment to the needs of the factory and large-scale working was not a mere question of rule-of-thumb or proportion. It has meant hard, persistent investigation under the different conditions and requirements of service. Without going into the difficulties at first encountered, and technicalities which would be irrelevant to the general purpose of this paper, it is now a fact that positive success has been attained in the application of town gas as a fuel for large furnaces in ordnance works, and a whole range of furnace requirements down to the smallest crucible furnace for gold-melting.

The oven or semi-muffle furnaces have the most extended application of any gas-furnaces. They are required by almost all manufacturing firms in one form or another for the various kinds of annealing, reheating, case-hardening, and hardening. These different operations require different heats. Light or heavy work will determine whether the furnace should be of medium or maximum strength in structure; while in each case the heat generated must be

FIG. 3.—NATURAL DRAUGHT GENERATOR OVEN FURNACE.

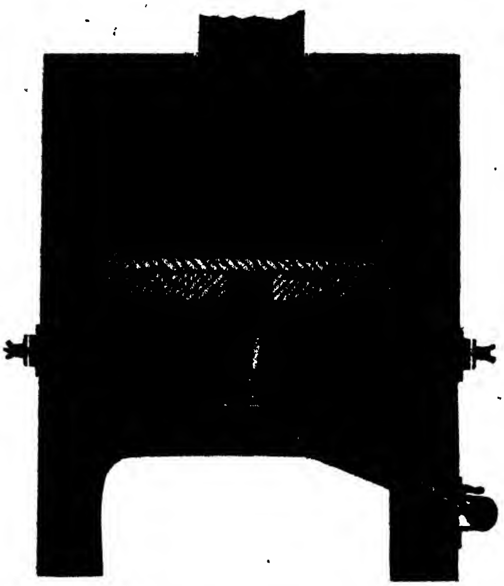


FIG. 4.—SECTION OF NATURAL DRAUGHT GENERATOR OVEN FURNACE.

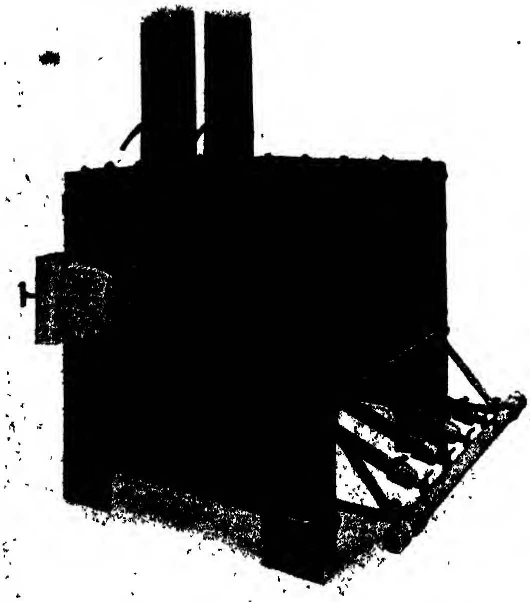


FIG. 5.—NATURAL DRAUGHT REVERBERATORY FURNACE.

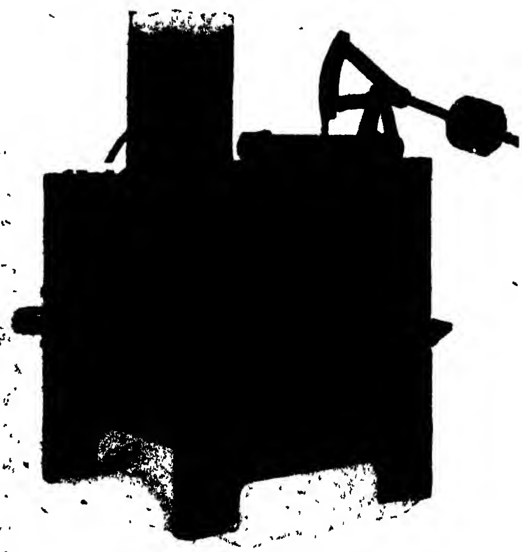


FIG. 6.—LOW-PRESSURE GAS AND AIR FURNACE.

TYPES OF GAS FURNACES (RICHMOND'S PATENT).

produced under the most economical conditions commensurate with uniform or even heating. These varying conditions have given rise to three distinct types of furnaces, each having a wide field of usefulness, viz. :—

(1) Natural draught generator oven furnace, suitable for annealing, reheating, hardening, and light case-hardening.

(2) Natural draught reverberatory oven furnace, suitable for annealing heavier work and case-hardening.

(3) Low-pressure gas and air oven or chamber furnace, suitable for annealing, reheating, hardening both high speed and carbon steel, case-hardening, forging, both heavy and light work.

Each of the two first-named furnaces has its own particular field of usefulness, while the third has such a wide range of temperatures—viz., up to 1,400° C.—that it has practically universal application.

(a) Natural Draught Generator Oven Furnace.

Illustrations 3 and 4 show this furnace and a cross-section. Special high-power bunsen burners are employed; the burner mouths being sealed from the air at the point of entrance to the combustion chamber. Primary air is admitted to the burner in reduced proportion; while combustion is supported by preheated air entering the combustion-chamber by a series of lateral air nostrils—these being heated by radiation from the floor bricks of the furnace. This furnace is very efficient, and particularly adapted to the lighter class of work—for example, the thermo treatment of motor gears, which itself represents a very large industry, the hardening of machine and other tools and parts made from carbon steels, the annealing of those parts, etc. The manipulation of this furnace is quite simple. Should a reducing atmosphere be desired for the thermo treatment of gears, etc., under non-scaling conditions, it is simply a question of reducing the air-inlets; whereas for higher temperatures the air-ports are left open. This furnace has been, and is to-day, a most satisfactory type for the work above described.

(b) Natural Draught Reverberatory Furnace.

Illustration 5 shows this furnace. Like its precursor, the generator furnace, it is on the natural-draught principle, and requires no mechanical plant for air compression. It is heated on the reverberatory idea—that is to say, the gas enters the furnace chamber, and pre-heated air runs along the furnace bottom through fire-clay nostrils, which meets burners at the points where combustion takes place. The flame then passes along the underside of the furnace-chamber roof, and downwards under the floor of the furnace chamber before entering the flues underneath, which find their exit up the side of the furnace wall. The furnace-floors are strongly supported—in fact, they may

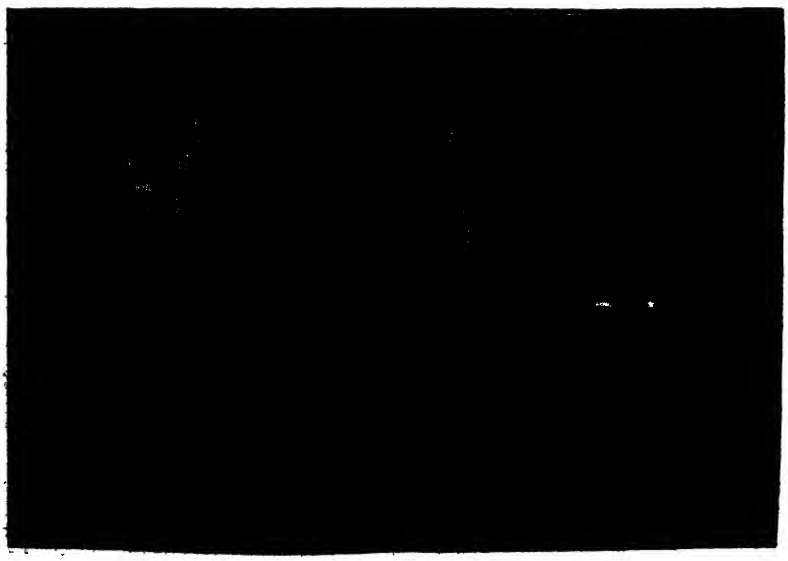


FIG. 7.—TWIN OVEN FURNACES FOR ANNEALING METAL STAMPINGS. Soft Metal Melting Furnaces also seen on right-hand side.

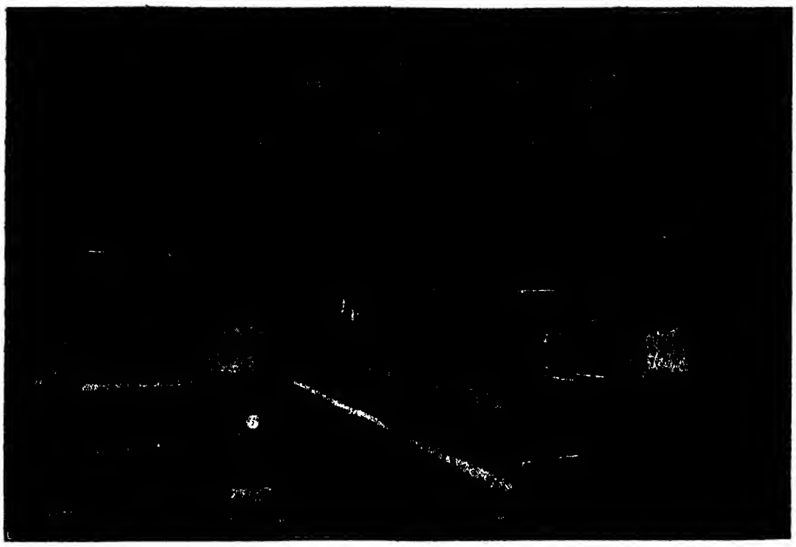


FIG. 8.—TWO 16-FT. STEEL BAR ANNEALING FURNACES OF REGENERATIVE TYPE.

be made to any reasonable thickness to suit the heavier class of work, such as carburising in boxes, annealing steel in bulk, normalising steel casting, etc. It will be noticed that this furnace has no combustion chamber other than the working chamber itself. Working results obtained from one of the largest factories in the kingdom prove this design of furnace to be of practical value, and a great success for the heavier class of work where heats up to 950° C. or 1,000° C. are employed, and no air blast is available.

(c) *Low-pressure Gas and Air Furnace.*

Fig. 6 shows this furnace. The principle involved is entirely new. Air at approximately 2 ins. water-gauge enters the firebrick lining at the roof of the furnace through a series of fireclay tubes from the main air supply. The air thus travels down the side, and along the bottom of the furnace, is preheated, meeting the incoming gas at the point where combustion takes place. The products of combustion then pass along the underside of the furnace roof, and downwards under the floor, as in the case of the reverberatory

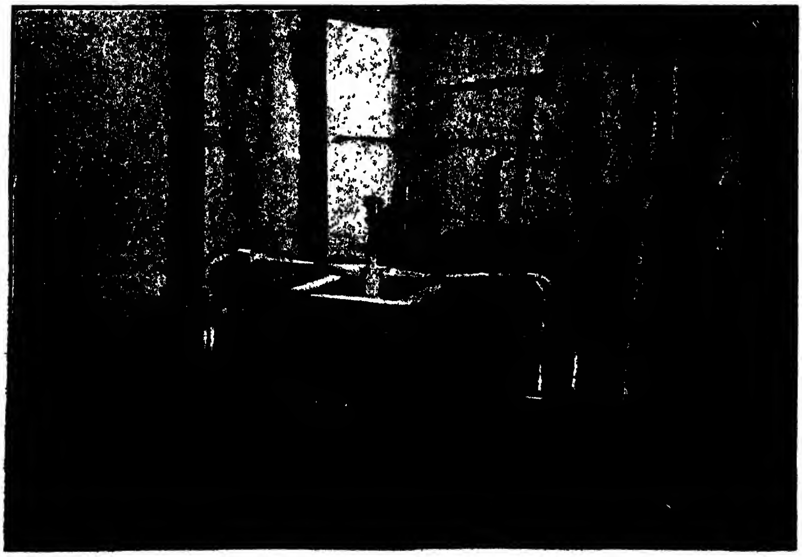


FIG. 9.—WELDING OF BAYONET HANDLES TO BLADES.

furnace. An oxidising or reducing atmosphere is obtained by increasing or diminishing the air pressure. Like the reverberatory furnace, it is of exceptionally strong construction; but it has advantages over the former, inasmuch as it covers a wider range of work—temperatures up to 1400° C. being obtainable. This furnace is suitable for all the operations before mentioned, besides which it can be usefully employed for the baking of emery wheels, firing of porcelain (with muffle), heat treatment of tungsten ores, heating up blanks for drop forgings. Generally speaking this furnace covers the widest number of working conditions, and has the advantage of being the most economical and efficient for the operations referred to. For annealing steel bar it supersedes the generator type of furnace, because it is possible to anneal under the most perfect conditions. In other words, the cooling process in steel annealing, which is spread over something like eighteen hours, may be achieved with this furnace, free from any possibility of cold air finding its way into the furnace chamber, and thus causing scale on the work, which, of course, is detrimental.

FIG. 10.—PART OF THE HARDENING SHOP OF AN IMPORTANT MOTOR AND ENGINEERING WORKS.

TYPICAL INDUSTRIAL APPLICATIONS.

To enter into a detailed description of the numerous industrial operations for which gas is, can, and will be used, or to give anything but very general particulars, would be an impossible task; but to give a brief review of its uses in some of our leading trades, I think, will be of interest to you.

ANNEALING.

For the annealing of stampings made from sheet-metal, gas is being increasingly used; and where the metal stampings are subjected to one or two heats only, a single oven furnace serves the purpose. Some stampings have to be subjected to the pressing or drawing machine four or five times or more, and require annealing between each operation. This is often the case with special forms of stamped or drawn nickel-silver, brass, etc. For this purpose a twin oven furnace is preferable; the top oven being used for preheating the articles gently before subjecting them to the full annealing temperature in the lower oven—thereby avoiding heat-cracking, which may take place when the single oven type is used. Fig. 7 clearly shows the working of this apparatus.

Wire manufacturers in some cases use gas-furnaces for annealing the finer grades of wire. At Cleckheaton (Yorkshire), the wire industry is responsible for a large portion of the 45 million cubic feet of town gas consumed per annum for industrial purposes. The heavier grades of wire

are usually annealed by hard fuel; but even at the present time gas-jets are employed at the entrance to the heated chamber to prevent the admission of air, and consequent scaling of the wire.

Fig. 11.—Gas-oven Furnaces for Tempering and Colouring Cartridge Clips.

Gas-furnaces can also be employed for annealing steel tubes, also for softening the ends of steel studs used in the motor and cycle chain-making industry. Steel pens, gun barrels and breeches, motor cylinders prior to repairing by the oxy-acetylene process, and many other articles are also annealed by gas.

Manufactured steel, in bars, is sent out by the makers in an annealed condition; and for this purpose gas-furnaces are being increasingly used. Fig. 8 illustrates two steel bar annealing furnaces. These are approximately 16 ft. long, from which fact it will be obvious they consume gas on a fairly large scale. Annealing in coal-furnaces necessitates packing the bars in a heavy cast-iron box to prevent scaling of the steel. This box is considered by some to be unnecessary in the gas-furnace, in view of the uniform conditions under which gas-furnaces work. The elimination of the box naturally means less absorption of heat. Decreased labour is also an important factor—in short, gas annealing has been proved very economical. In many of the smaller steel works where annealing is intermittent, the saving achieved by the use of gas-furnaces is something like 50 per cent. in the cost of fuel alone—a fact in works' economy which cannot be ignored by the manufacturer in these days of keen competition.

The following are figures obtained from actual working:—

Annealing Steel in Richmond Regenerative Gas Oven Furnace.

	Carbon Steel.	High-speed Steel.
Weight of charge	35 cwt.	45 cwt.
Total time of heating	6 hours	9 hours
Time of cooling	42 "	40 "
Total time of operation	48 "	49 "
Maximum temperature attained	880° C.	875° C.
Gas consumption per ton of steel	3600 cubic feet	5000 cubic feet
Cost of gas per ton of steel annealed with gas at 1s. 6d. per 1,000	5s. 5d.	7s. 6d.

Succeeding Operations.

Following the progress of the steel bar to the manufacturer of hand and machine tools, gear-parts, mining and agricultural implements, cutlery, ordnance materials, electrical appliances and the manifold component parts of machinery, we come to the processes of hardening, case-hardening, and tempering.

Hardening.

This process, as you will be aware, is the one whereby steel is converted into its hardest state by being subjected to heat and quickly quenched off to a cold temperature, either by means of liquid, or by air blast.

Case-Hardening.

This is the method of converting mild steel, which will not harden direct, into a steel which will harden glass-hard on the surface when quenched off in water, leaving a soft core in the centre of the bar; making practically an almost unbreakable steel. This steel is, for example, very suitable for gear wheels, cam shafts, bicycle and motor parts. After the carburising process is complete, the steel article is subjected to a hardening process, which varies according to the different methods in vogue, and is generally known as the "thermo treatment" of steel. For all these operations gas-oven furnaces are being increasingly used.

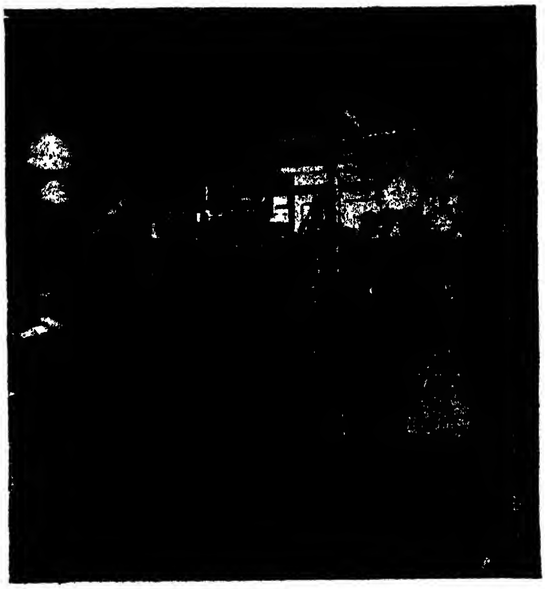


Fig. 12.

Lead-melting Furnaces at "Lloyd's Newspaper."

Tempering.

Here we have the process of heating up hand and machine tools, gearings, etc., to the temperature which is known to give the temper to the steel. The operation is carried out by two

Fig. 13.—Part of one of the Laboratories of the Imperial College of Science and Technology, South Kensington, showing a Suite of Assaying Muffles.

different methods—*i.e.*, tempering by colour, or by temperature. Such articles as razors, shear blades, saws, and articles of a kindred nature are frequently tempered by colour on an open or covered heating plate. Tempering by colour of smaller articles is more generally executed in rotary furnaces—*e.g.*, the tempering of motor and cycle chain links.

Messrs. Gillott, of Birmingham, use a rotary furnace for tempering steel pens.

Tempering by temperature without colour is done in furnaces containing oil, fat, lead, or salt mixtures.

The various and complex methods of the thermo treatment of steel to which I have referred in necessarily (owing to time) a somewhat cursory manner, and which differ according to the qualities of steel and methods adopted, illustrate the wide field of usefulness for town gas in all hardening shops—in fact, wherever manufactured steel is used.

Gas and the Production of Munitions of War.

At this critical time in our national history, those of us engaged in the gas industry are naturally highly gratified at the wide extent to which gas is used in the production of our armament and ammunition, in factories, in shipyards, and in Government works. It would hardly be too sweeping an assertion to state that all the requirements of our Army and Navy are under tribute to gas in some way or another.

For instance, the heat-treatment of shells—a matter of vital interest to our national existence at the present moment—is largely carried out by the use of gas furnaces; and the extension of their use in this direction is almost a matter of daily occurrence. Some of these furnaces are comparatively small; but even the largest shells are to-day being treated in this country in gas-furnaces. One furnace recently supplied to an armament firm holds at one charge eleven of the largest naval armour-piercing shells—each shell weighing over one ton. Owing to its size, this furnace had to be dispatched in sections to the works where it is in operation; and therefore could not be photographed.

Oven furnaces, similar to those I have previously described, are used for annealing component parts of revolvers.

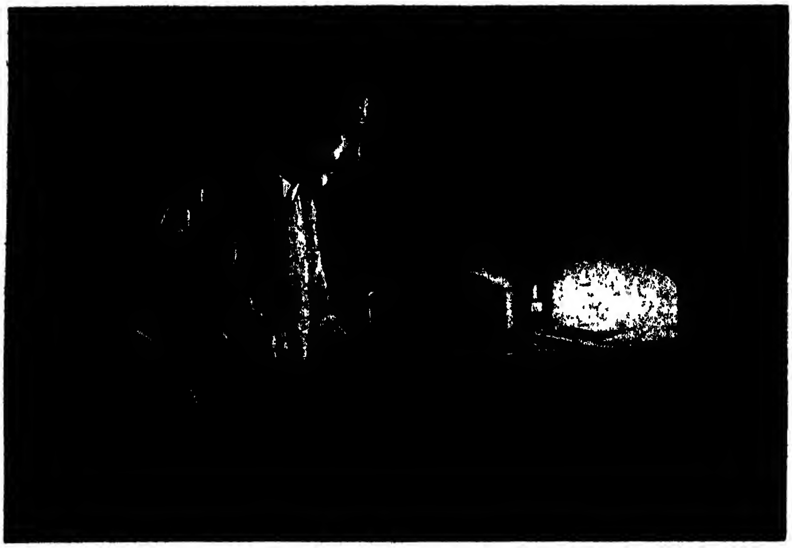


Fig. 14.—Firing Enamels on Jewellery, etc., in Muffle Furnace.

A further instance of the national value of gas during the last eight months in fitting out our new Army is seen in Fig. 9, which shows the heating equipment used in the welding of bayonet handles to their blades.

Fig. 10 illustrates part of the hardening shop of an important motor and engineering works associated with a famous armament company. You will notice here that all the furnaces use gas as fuel; and, since the war started, additional ones have been installed, greatly assisting the output of gear parts, etc., for transport and other vehicles. There are also quite a considerable number of manufacturers who, finding the demand for their usual commodities

considerably lessened, if not entirely, though temporarily, wiped out, have been enterprising enough to adapt themselves to the special demands of the present time, and have had their energy and perspicacity amply rewarded. This conversion of old, and the initiation of new industries have been going on in this country to a larger extent than is generally known; and in these changes is one more tribute to the genius and energy of the British manufacturer. To the availability of gas, and its elasticity in application, is due the possibility of making these developments, and of making them so promptly and rapidly. Any number of gas-fired furnaces for any kind of heat treatment can be installed; the gas and (if necessary) the air-blast can be connected in almost a few hours; and the new class of work can be inaugurated at once. To give only one example, a company manufacturing musical instruments found the public demand in war time somewhat lessened. The illustration (Fig. 11) will show you gas-furnaces that were ordered and installed in a few days; and the same shop which produced the former has been transformed into a highly important adjunct to our Army supplies. The operation, you will observe, is the tempering and colouring of the small steel cartridge clips; each furnace dealing with about 10,000 clips per day.

Another specific instance of how gas has served us during war time is in our air-craft factories, where gas-furnaces are used continuously both in the Government and private works which are unceasingly active day and night to enable the country to maintain its supremacy in the air. Unfortunately (perhaps otherwise), I have not been allowed to photograph any of the air-craft factories where gas-furnaces are in use.

The Heat-Treatment of Metallic Ores.

This is an industry which has hitherto been largely developed in Germany, and since the outbreak of war the manufacture has been energetically taken up in this country. These ores which form alloys for special steels are heat-treated in high temperature gas-heated oven furnaces, and roasted at lower temperatures in a similar type of oven.

Metal-Melting.

Let us consider for a few moments the subject of metal-melting. The applications of gas for metal-melting are particularly varied. It is used by gold refiners, jewellery manufacturers, goldsmiths and silversmiths—in fact, wherever precious metal is melted from its solid state for any manufactured process, gas is found to be the most satisfactory fuel.

The melting of brass, aluminium, admiralty, and other alloy metals also present an important opening for the application of gas-heated crucible furnaces.

Lead and metal melting is found in many industries. One of the chief and most familiar

Fig. 15.

Steam Generators for Heating Printers' Presses.

trades to which gas for lead melting can be applied is the printing trade. In every town—metropolitan or provincial—the printing trade is represented in some form or other. The type-founder who supplies the type for the printer requires a lead-melting furnace for type-founding, the stereotyper for stereotyping, and the general melting of metal for composing machines, which is a daily process in large printing offices. Fig. 12 shows Lloyd's newspaper type-foundry with lead-melting furnaces. One could continue enumerating the applications

of gas for melting metals; but enough has been said to show the extensive possibilities for this purpose.

An "internal" heater, suitable for melting soft metal, boiling liquids, etc., has recently been introduced. This "internal" heater is immersed in the metal or liquid; and therefore the heat utilised is greater than if the burners are placed beneath the tank in the ordinary way.

One particular operation for which this is being used is the heating of vats containing 200 gallons of cold water. Into these, bones are placed and steeped for about four hours, after which the gas is lit; and the hot water cleanses the bones and extracts the marrow. The method previously employed was the injection of steam into the vats; and owing to these being constructed of wood, any ordinary method of gas-heating would have been difficult. The invention, however, of this "internal" heater solves the problem; and it is performing the work very satisfactorily.

Varnish Making.

Gas-boilers for the making of varnish are being rapidly installed in preference to coal-fired boilers, and have proved to be quicker and cheaper for an equivalent amount of work.

The results in one instance were as follows:—

With coal-firing, the time taken was six hours, and a coal consumption of 2¼ cwt. at a cost of 1*s.* 4½*d.*

With gas-firing, the time taken was two and a half hours, and with a high-power burner consuming 150 cubic feet per hour, the total consumption was 375 cubic feet. The approximate expenditure was about 8½*d.*, free of all labour cost, with the advantage of an increased production and absolute safety from fire, which is a vital factor in the manufacture of varnishes.

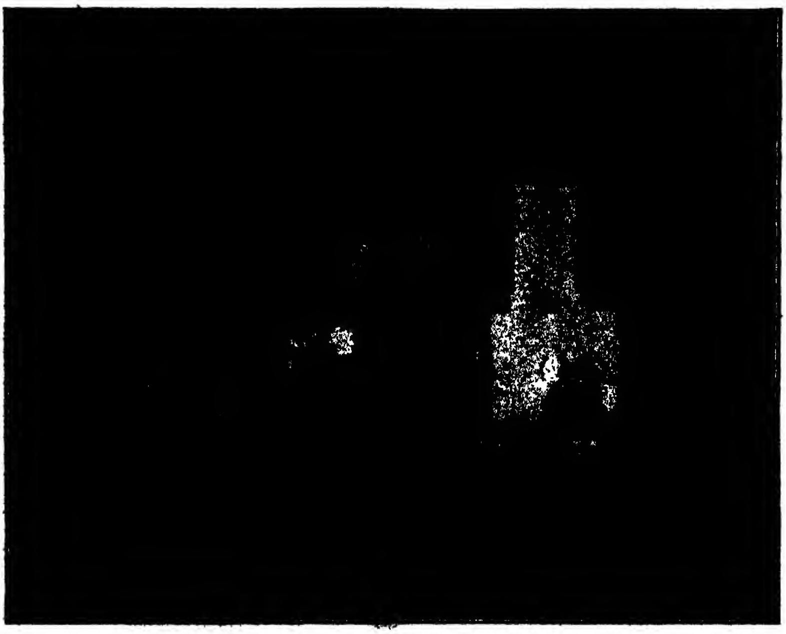


Fig. 16.—"Glory Hole" Furnaces for Heating and Re-heating of Glassware during Formation and Finishing.

Brazing, Blow-Pipe, and Soldering Work.

For brazing, blow-pipes with gas and air-blast or high-pressure gas are extensively used. Marine engine works and copper tube works have been brazing heavy flanges on copper pipes with hard-fuel brazing furnaces; but quite recently some of them have been persuaded to use gas for this purpose. In this case, the advantage as compared with the hard-fuel system is that the metal and flux are kept clean and free from particles of dust, and, therefore, a more reliable joint is made.

Recently a new brazing method came to my notice. An engineer associated with the Indian railways has introduced a new brazing material in connection with which he advocates the use

of town gas. Heavy castings, such as large cog-wheels and embossing presses, which have been fractured, have been successfully repaired with his brazing material by the use of gas blow-pipes. Blow-pipe work has many applications other than brazing. For instance, electric lamp bulbs are sealed by gas.

Another electrical firm consumes gas freely for industrial purposes, using gas-fed soldering irons in the manufacture of armatures.

A large factory in the east end of London, which produces about 14 million tins per annum, and is at present engaged on a large Army contract for tins to contain rations and biscuits, uses about fifty gas-heated soldering-iron stoves. In addition to this, these manufacturers use several gas-heated machines for the spreading of rubber rings to make joints for "decorative work"—*i.e.*, tins with enamelled exteriors to contain liquids, such as paint, foodstuffs, etc.

FIG. 17.—THREAD-SINGEING MACHINE FOR REMOVING SINGLE THREADS OR STRANDS.

ASSAYING.

In all metallurgical laboratories, public and private, chemical laboratories, research departments of public companies, and also by analytical chemists, we find useful work for gas. Fig. 13 shows one of the laboratories of the Imperial College of Science and Technology, South Kensington, fitted with fifteen muffle furnaces, which are employed for the assaying of metals by the mining engineer students.

The Metallurgical Laboratory of the Birmingham Municipal Technical Schools is also fitted with gas muffle furnaces.

In the assaying laboratory of the Heriot-Watt College, Edinburgh, which is one of the best equipped institutions in the country, there have been installed gas furnaces for experimental and demonstration work.

ENAMELLING.

In the art of enamelling on metal, china, and pottery, and gilding on glassware, gas is being used most successfully. The famous Ruskin pottery, for some of its finer productions, is fired in gas-heated furnaces. Fig. 14 shows the process of jewellery enamelling; and the same kind of muffle can be used for all kinds of enamelling on metal.

JAPANNING.

As a few examples of the very extended use of japanning ovens, I might mention the cycle, bedstead, gas-stove, fire-grate, electrical, tin-ware, brass hollow-ware trades, as well as many others.

Steam.

We now turn to the raising of steam by gas; and the next illustration (Fig. 15) shows the gas-steam generators for heating printing-presses.

Steam is also required in the bending and shaping of cardboard, wood, umbrella-handles, walking-sticks, and many other similar articles. Gas is used, and could be universally and economically employed in all these processes.

Glassware Industries.

Quite recently there has been a distinctly forward movement in the adoption of gas for the different heating operations in the manufacture of glassware, and the further growth of this trade, owing to the war and cessation of supplies from Germany and Austria, will be considerably advanced by the aid of gas. During the operation of glass-blowing, the glass under process of formation requires re-heating to maintain it in a plastic condition. For this purpose gas-furnaces, called by the trade "glory holes," are now being used. These furnaces are also used for obtaining a good finished surface on moulded glassware. Fig. 16 shows two in operation. As soon as the glass-blower has finished his work on the article, it is immediately transferred, while hot, to a low-temperature furnace to allow gradual cooling. In some of the modern glassworks the furnace for cooling down is of the Lehr type. These furnaces are usually from 40 to 70 ft. long, and about one-fourth of the length is heated by town gas to a scarcely visible red temperature. The hot gases from this portion of the furnace travel through the remaining length, thus giving a graduated heat. The articles are placed in the warm end of the furnace and travel down very slowly towards the cool end, carried on rectangular iron trays, which are attached one to another. These trays are drawn along by a hand-winch with ratchet 2 ft. every thirty to sixty minutes, according to the class of work.

In the stained-glass trade, gas kilns for firing glass are used. The colours are painted on the glass, the glass is placed on a trolley, and is wheeled into the kilns, the firing taking from thirty to sixty minutes.

Fig. 18.—Cloth-singeing Machine for removing Nap and Loose Threads.

Sugar-Melting.

Considerably over 350,000 tons of sugar are melted annually in this country for the production of jam and confectionery, and gas is coming to the front in this direction, and results can be obtained with it that should ensure a much more general use for the numerous smaller sweet factories and trades, which may be found in almost any town.

Cotton.

We are well aware how much we rely for our prosperity upon the cotton and woollen industries; Lancashire and Yorkshire between them supplying the whole world with their manufactures in some form or another.

Fig. 17 shows how gas is used for the purpose of thread-singeing. The thread is automatically

wound off a bobbin, and passed through a naked gas flame on to another bobbin at the rate of 200 yards per minute; the single threads or strands being burnt off (singed) in the process.

Since the introduction of the present gas method, the improvement in the quality of the material, and in other directions, has been considerable. A machine (as shown) will use about 300 cubic feet of gas per hour; and it will, therefore, be understood how great is the consumption of gas throughout the County Palatine for this one industry alone.

bleaching or scouring. The machine is made specially for use with gas by the largest manufacturer of textile machinery. The consumption varies according to the quality of cloth and the number of gas burners used; but a single-burner machine, with ordinary width cloth, consumes from 200 to 250 cubic feet per hour.

Tentering is the stretching of the cloth. To enable this work to be carried out more effectively, the cloth is first moistened by being passed through or over a steaming-chamber or damping-box. It is then clipped at each side,

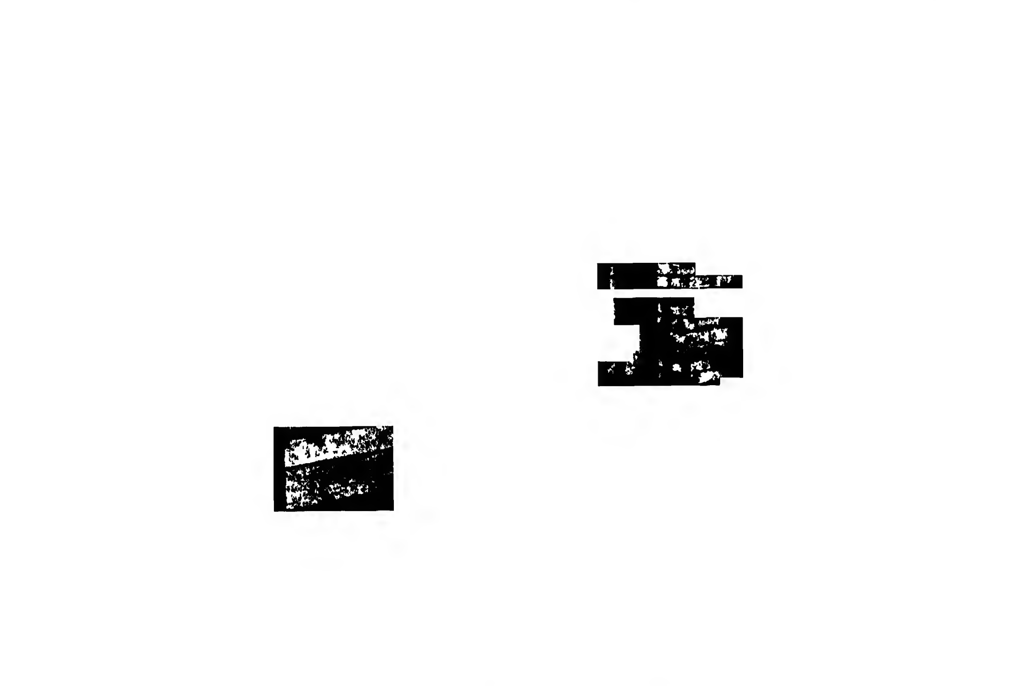


FIG. 19.—MAKING PEAK CAPS FOR HIS MAJESTY'S FORCES.

CLOTH INDUSTRY.

Fig. 18 gives some idea of the gas appliances used in the cloth industry. Here we see the material being singed. This process consists in burning off all the nap and loose threads from the cloth. It is the first stage in the preparation of the cloth for bleaching, dyeing, printing, and finishing; and in this way the surface of the cloth is prepared for the various finishes which it is desired to obtain, and made suitable for being printed upon. The cloth is passed over gas burners at a speed varying from 80 to 200 yards per minute, according to the class of goods being treated. It is then run through water to extinguish sparks, and is left in the wet state until it undergoes the subsequent operations of

stretched, and passed through the machine at an average speed of 40 yards per minute. In its passage through the machine, it passes over gas flames, above which is placed a copper sheet, which, when heated by the gas, drives the steam and moisture out of the cloth.

HAT TRADE.

In the making of felt and silk hats, gas can be used from start to finish—shellac for stiffening, pressing for shaping, burners for singeing, irons for velouring.

Referring again to military requirements at the present time, we have in Fig. 19 an illustration of a large London factory, which is turning out daily 4,500 peak caps for our soldiers. On

the right-hand side will be seen a battery of thirty-six irons heated by gas, while the steam blocks on which the caps are shaped are also heated underneath by means of bunsen gas-burners.

Boot Trade.

The boot trade is dependent upon gas in several of its processes. Specially designed gas-heated apparatus is used at the Shurephit Shoe Factory for drying the cement used for "blocking" the toe-caps of boots.

It is a circular table, in the centre of which is a metal chamber heated by gas. In this, holes are cut to allow the toe-caps of the boots to enter in order that the cement may be artificially dried. It is made to revolve so that there may be as little running about as possible on the part of the boy who attends to this work.

Gas is also used for "ironing" (that is to say, finishing off the boots by ironing the surface of the leather) and "treeing" (that is, making the boots take the exact shape of the last on which they are modelled).

The gas is supplied to the centre of the apparatus; and the irons are heated within arm's-length of the ironers, so that no time is wasted (as was the case with the more old-fashioned systems) in passing to and from a stove with the irons.

It may also be mentioned that gas is employed for heating the irons for polishing the heels and soles of the boots and shoes. Another large boot factory in the same district uses gas entirely for power, lighting, and manufacturing purposes.

The Universal Servant.

The illustrations shown are but a very few of the many—the thousand-and-one—photographs that I could have used to demonstrate the multifarious practical applications that have already been made of gas in manufacturing processes. Only the limits of time at my disposal have prevented me from giving many others of equal interest and importance.

Fig. 20.

May I, however, in concluding my paper, express the hope that the little I have said, and the few illustrations I have shown, have sufficed to make it clear to you what a universal servant to man gas is? Our hats, collars, clothes, buttons, socks and stockings, umbrellas and walking-sticks; the making and blacking of boots, the books and newspapers we read, the pens with which we write, the motor-cars in which or the bicycles on which we ride—all owe something to gas in their production. Then, again, the stained glass in our churches, the fire extinguishers, the beds in which we sleep, and what is of vast importance to us as a nation, the armaments for our Army and Navy—shells and ammunition, guns, rifles, bayonets, swords—in the manufacture of each and all of these gas is largely used, and of my personal knowledge I know that the enormous output of

war material we have received from our manufacturers during the last few months could not have been made so rapidly without the aid of industrial gas appliances, many of which in their present economical, effective form are of comparatively recent introduction. It is, I venture to claim, largely due to the service of industrial gas apparatus that our new Army is in a position to take the field much earlier than otherwise could have been the case. Gas manufacturing is one of our greatest industries; no industry has ever been developed which has been of more service to the public. It has been in a letter to the *Times* said: "The stone is to no small extent rotten behind the crust, and analysis shows that this condition is entirely due to the action of coal smoke."

I am convinced that the further introduction of gas firing, in substitution for hard-fuel direct-firing, will aid materially in the solution of this great and urgent sanitary problem—the abatement of smoke. We may not live to see the supreme reign of this order of things, but each and everyone can do his part in advancing the rate of progress in the new era of industrial gas-heating; thus utilising to the

FIG. 21.

shown in many ways that the use of gas cookers, gas fires, gas water-heaters for domestic purposes in our large cities and towns, has been, in addition to many other advantages, accompanied by a marked increase in the number of hours of sunshine enjoyed by the community per annum, and a decrease in the number of dirt-producing and unhealthy fogs. This is emphasised pictorially by Fig. 20, showing a view of part of the roofs of London, among which the dome of St. Paul's is prominent, in the early morning in the height of summer, when domestic fires are not required, and before the factory chimneys have commenced their daily output of smoke; and by Fig. 21, showing the same scene on an ordinary working day. After an examination of the east side of Canterbury Cathedral, the architect to the Dean and Chapter of Canterbury, best advantage one of the greatest sources of power provided for industry by Nature, and so conserving that great national asset, our stock of unmined coal.

DISCUSSION.

THE CHAIRMAN (Mr. D. Milne Watson), previously to discussing the paper, expressed the regret he felt—which he was confident was shared by the meeting—at the absence of Sir Corbet Woodall, who had intended to take the chair. Sir Corbet had been looking forward to presiding at the reading and discussion of Mr. Thornton's paper, but had been forbidden by his doctor to be present. All would desire Sir Corbet's speedy return to health and strength. It had been a great pleasure, as was always the case when a man read a paper on his own subject, to listen to Mr. Thornton that evening. Mr. Thornton

was so eminent an expert that what he had to say had been of the highest interest. The numerous illustrations thrown upon the screen showed how great was the diversity of uses to which gas could now be put; indeed, there was hardly any manufacturing process to which it had not been applied, and the progress during the last few years had been of a most astonishing character. Sir Corbet Woodall, speaking of the present paper, had recently told him that he (Sir Corbet) had taken the chair, for the first time, at the Royal Society of Arts thirty-five years ago, and he believed that, at that time, not more than 5 per cent. of the gas used was employed for purposes other than lighting; to-day, however, no less than 40 per cent. was so used. That was splendid progress; but those who were gas men believed that this 40 per cent. only marked the beginning of the era of industrial application of gas. If any present were spared to come to a lecture at the Royal Society of Arts thirty-five years hence, the reader of the paper would then have a very different story to tell. As Mr. Thornton's paper had amply and fully shown, it was impossible to turn in almost any direction without finding that gas was being applied to industrial uses. The paper was the more apposite just now, as gas men were living under a cloud. The price of gas had unfortunately been necessarily raised, and many were feeling somewhat gloomy as to the immediate prospects. It was certain, however, that Mr. Thornton's paper had given a fillip to matters. The advantages of gas were so great and unquestionable as to compensate for the temporary difficulty in regard to price. After all, however, the price of gas was not such a very serious matter. Admitting that the price had gone up 18 to 20 per cent., yet, seeing that the manufacturer was able to make and deliver gas at an advance of 18 to 20 per cent., notwithstanding that coal had gone up some 300 per cent.—account being taken of carriage—he considered that the gas manufacturer was doing very well. In conclusion he would thank the author for a most interesting and illuminating paper.

Mr. W. E. Price considered that the paper required to be taken home and well digested by those who were not wholly familiar with the uses of gas; not till then would they begin to appreciate the value of the extent to which gas had been applied to work in this country. The point which Mr. Thornton had referred to early in his paper, namely, the amount of coal used in a crude and old-fashioned way—where it was burnt to destruction and much of its value lost up the chimney, as shown by the lantern-slides illustrating the roofs of a certain portion of London, presumably on an average day—proved the great advantage of gas, an advantage which he hoped would, before long, be increased by the compulsory abolition of the use of coal in the way in which it was still being used. The benefit to be derived was not merely financial; it was also an industrial benefit, and one of hygiene. The work Mr. Thornton had done, and the effort he had made, were very valuable.

Mr. F. W. Goodenough agreed with Mr. Price in thinking that the paper did not call for criticism or discussion, being a statement of the position of industrial gas at the present time. It was, he was sure, most gratifying to all connected with the gas industry to have heard the paper, which must have come as a surprise, even to the best-informed. He would only suggest that Mr. Thornton might have included the crematorium in his summary of uses. The author had shown that gas was used in connection with almost everything from early life, such as the heating of babies' food by the gas-ring, onwards. It was even used in connection with the humbler animals, the dogs' homes being a case in point. The Society was greatly indebted to Mr. Thornton for having devoted so much time and labour to the preparation of a very comprehensive paper, which would be treasured for a long time to come as a full record of the position of the industrial application of gas in 1915. It would be difficult, as the Chairman had suggested, for the most optimistic to forecast what would be the condition of the gas industry in 1950. It was, however, at least interesting to note that the percentage of gas used for purposes other than lighting had gone up from 5 per cent. to 40 per cent. Of course, if it were expressed in quantity the increase would appear enormously greater, because the total quantity of gas used to-day was probably at least ten times as much as thirty-five years ago. The figure would therefore be 40 per cent. on 1,000 instead of 5 per cent. on 100.

Sir Henry Trueman Wood, while not proposing to discuss the paper, desired to draw attention to the manner in which the hall of the Society was lighted. Thanks to the liberality and care of the Gas Light and Coke Co., and thanks especially to the influence of Mr. Goodenough, the Royal Society of Arts was happy in the possession of the latest form of gas lighting, and it seemed proper to the occasion that gas light should be used that evening to the exclusion of its rival, electricity, which, of course, was generally used with very satisfactory results. He would remind the meeting that the Society had done its share in promoting a knowledge of the progress of the gas industry. The Society had been among the first to use gas for its outdoor lighting—at that time it was not an illuminant which any reasonable being could introduce into a house. In the first quarter of the nineteenth century, the Society had also given prizes for the early utilisation of by-products, for improvements in gas manufacture, for the first gas-holder, and for the first gas-chandelier, of the old water-seal type. It was in the hall of the Society that Mr. Fletcher had described—the speaker did not think for the first time—his researches in what he had called "flameless combustion," at

which all the chemists had laughed. This, however, had—the speaker believed—since developed into the latest production, described before the Society last year, known as the "Bonecourt furnace." He considered that from the beginning of the use of gas to the present time, at which such an admirable and exhaustive paper on the practical applications of gas had been presented, the Royal Society of Arts, had done its share in extending a knowledge of the manufacture and uses of that important illuminant.

Mr. Leon Gaster did not propose to discuss the question of the use of gas for lighting purposes, but, from personal experience, he could corroborate what the author had said with regard to the industrial uses of gas. He was connected with large factories, for Government work, using gas for ironing purposes in the manufacture of clothing and caps, and he found the latest types of irons much more efficient than the old types. He could, indeed, have wished that Mr. Thornton had taken an opportunity of securing photographs from some clothing factories. The use by big caterers of gas for cooking purposes was another application to which he might refer. The speaker was himself connected with a company using millions of cubic feet of gas for this purpose, and the gas had proved a tremendous advantage, especially where there was not room for the storage of coal. Finally, he would refer to the application of gas in the drying and cleaning trades, where he had found it a great help.

Mr. Campbell M. Hunt remarked that papers fell usually under two categories, namely, those which were open to discussion and adverse criticism, and those which disarmed criticism by the quantity of valuable matter they contained. Mr. Thornton's paper was of the latter order. Sir H. Trueman Wood had referred to the fact that the Bonecourt boiler had been discussed by the Society last year, and, in this relation, the speaker would say that he understood considerable progress had been made, during the past few months, with the simplification of this boiler, and he believed the Bonecourt system of surface-combustion was being applied to industrial purposes. He would be glad if the author could say anything in regard to this point.

Mr. H. M. Thornton, in response to the question put by Mr. Hunt, remarked that he believed developments to have been made in the application of the Bonecourt system for industrial purposes. The company was, however, so well known, that he felt confident that if Mr. Hunt applied directly to the company they would give him any particulars he desired.

The Chairman then proposed a hearty vote of thanks to the author for his admirable paper, which was unanimously carried.

Mr. H. M. Thornton replied briefly to the general remarks which had been made, observing that the enthusiastic reception of his paper had repaid him well for any trouble it had given him to prepare. The subject of industrial gas was one that he had much at heart, and the study of it had interested him for some years. The more he investigated the matter the more convinced he felt that, by giving to the public all the particulars he could in regard to the many uses of gas from an industrial standpoint, he was performing a public duty. He had tried to show how great an advantage it had been to the nation in the present crisis; and if he had succeeded in establishing that the use of industrial gas furnaces had expedited—as he was satisfied it had—the turnout of Army and Navy requirements, and had brought nearer the day when hostilities would cease, he had done something to help the nation at a trying time.

The proceedings then terminated.

NEW TWO-COLOUR PROCESS.

At the meeting of the Royal Photographic Society, held on March 9th, Mr. G. E. Brown described a new process for producing coloured pictures by photography, which has been worked out by Dr. Kenneth Mees at the Kodak Research Laboratory in Rochester, New York. Mr. Brown remarked that most methods of colour photography depended on the use of three coloured lights projected on a screen, or upon the superimposition of three coloured impressions respectively complementary to the colours which were recorded in taking the negatives. An obvious step towards simplification was the substitution of two colours for three, as already adopted in the "Kinemacolor" process of cinematography, in which two negatives were used, red and green, and positives from these were projected alternately upon the screen through red and green filters.

In the new process, which from its origin was entitled "Kodachrome," two negatives were taken through red and green screens, and each negative was converted into a coloured positive by bleaching out the silver image, and dyeing the bleached film with a complementary colour. The two plates thus obtained were combined into a single transparency, which reproduced with very considerable accuracy the colours of Nature.

As a result of only two colours, red and green, being used in the process, the rendering failed in respect to blues, violets, magentas, and purples, but it did excellent justice to flesh tints of all kinds, shades of red, orange or green, and greys and blacks. The results at times appeared to show blues well by an optical illusion, blue-greens appearing blue in contrast with greens. The results appeared at their best when shown by artificial light. In taking the negatives the time required for two successive exposures by powerful artificial light was about three seconds altogether. If thought well the original negatives could be

reproduced by the medium of a positive, and retouching carried out at either the negative or positive stage.

A number of examples of the process were on view, being shown in each case, mounted in an illuminator having the appearance of an ordinary picture-frame with heavy moulding, and containing an electric lamp. It was seen that the colour rendering of flesh tints and the general photographic quality of the transparencies were of an exceedingly high order.

EMPIRE NOTES.

Colonial Fisheries.—A very important step has been taken by the New South Wales Government for the development of offshore fishing in Australian waters. They have acquired for this purpose three Grimsby trawlers, fully equipped and manned by crews of carefully selected North Sea fishermen. At a meeting in Grimsby, held last month, just before the trawlers left for their distant scene of operations, which was attended by the skippers and others concerned in the undertaking, Mr. Stead, the representative of the New South Wales Government, by whom the purchases and the necessary arrangements had been made, gave some particulars of the prospects of the scheme. He stated that on the coast of New South Wales there were very rich offshore fishing grounds, and also enormously rich surface fisheries. Most of the kinds of fish seen in the North Sea, Iceland, etc., were absent, but large numbers of flat-fish (flounders and soles) were to be met with. The principal fish were those of which the gurnard was the nearest type in English waters, about three or four feet long, called "flatheads." He considered that within the 100-fathom line, which averaged from 20 to 30 miles, there were about 9,000,000 acres of suitable trawling ground, inshore. There were many good trawling areas, but the principal fishing grounds were at a depth of from 80 to 150 fathoms. In the surface waters, there were large Spanish mackerel, which could be secured in great quantities with practically any sort of tackle and bait. The example set by the New South Wales Government may and probably will be adopted by other Australian State Governments, should the present venture prove a success. In the fisheries of the Dominions the Empire possesses a vast source of wealth, which hitherto, except in Canada, has been but little developed. Canada has found her fisheries to be a very valuable asset, the development of which is a subject of constant care on the part of the Department of Fisheries. The Forty-seventh Annual Report of that Department, just issued, shows that the total marketed value of all kinds of fish, fish products and marine animals, taken by Canadian fishermen from the sea and inland lakes and rivers during the fiscal year ending March 31st 1914, amounted to $33,207,748. There were 71,766 men employed in the work on 1,992 vessels, tugs and smacks, and 37,688 boats; while 26,893 persons were engaged in the fishing industry on shore in canneries, freezers, fish houses, etc. Of the total, there were 86,436 engaged in the sea fisheries and 12,173 in the inland fisheries. The extensive coast lines of Canada and Australasia, not to speak of other overseas countries under British rule, with their vast extent and variety of inland waters, afford practically illimitable opportunities for the development of this great industry.

War Equipment from Canada.—In October last the War Office sent a Purchasing Commissioner (Mr. F. W. Stobart) to Canada to obtain war equipment. Since that date the Commissioner has placed 255 contracts, of an aggregate value of $80,000,000. Of this sum, says the Toronto *Mail and Empire*, only $765,000 went to the United States for goods which Canada could not supply. More than nine-tenths of the expenditure has thus been made in the Dominion, keeping Canadian workmen and capital employed. An inventory of the purchases includes sheep-lined coats, sweater coats, wool vests, wool and cotton drawers, wool and leather mitts, socks, cap comfortings, flannel shirts, cholera bands, rubber boots, boot-laces, buttons, leather accoutrements, packs and haversacks, binoculars, razors, shaving brushes, mess tins, clasp knives, halters, railroad ties, posts and pegs, shovels, and pick handles. In addition, Colonel Barton has spent $5,000,000 for great-coats, jackets and trousers for the British armies. Altogether, $16,000,000 has been spent on woollen goods from Canadian mills, including $6,500,000 for khaki clothing, $1,250,000 for knitted articles, and $1,500,000 for blankets, upon which twenty-eight factories are now employed. Among the details of the purchases are 28,000,000 trouser buttons, 750,000 pairs of socks, 120,000 shovels, 1,500,000 woollen under-drawers, 250,000 cotton under-drawers, 10,000 sets of military accoutrements a week, 200 bicycles, 100 motor-cycles, and 200 motor-trucks. The Imperial Government has also ordered $30,000,000 worth of shrapnel shells, in the production of which, with cartridges and shell parts, 147 Canadian firms are engaged, which are aiming to produce 15,000 shells a day. The lead bullets come from the mines of British Columbia, and the steel and brass fittings and explosives are also of Canadian make. Even railway shops are being used in the manufacture of this war material. But not only is the British Government a large customer for war material. Russia is said to have bought $3,000,000 worth of Ross rifles, while the French Government's orders for saddlery, harness and other goods run into large figures. It is estimated that the war outlays by the British and Allied Governments will amount to several hundred million dollars. If to these purchases of war material there be added the orders for foodstuffs, which will become increasingly large as the war proceeds, the advantages offered by the Dominion to the Allies for the supply of the necessaries occasioned by the war will be incalculable.

Canadian Industrial and Labour Conditions.—The Department of Labour at Ottawa, in its latest report published in the official *Labour Gazette*, reviews the present industrial and labour conditions of that country, which may be regarded as encouraging, considering the dislocation of trade caused by the war. The Department reports a slight reduction in the number of persons unemployed throughout Canada, which it ascribes mainly to the work being provided by municipalities to meet the present need, but a large contributing factor is found in the fact that "the internment of aliens of enemy nationality continues to give a very considerable measure of relief." From this statement it may be inferred that there is, in the towns, a large foreign element, which has hitherto competed with Canadians and with British immigrants in the labour market. In regard to agricultural employment, an encouraging note is struck, as we are told that many farmers, who had left their farms for the cities, are going back to the land. Evidently the expectation of good prices for their produce is leading a number of men who had, with their families, given up farming for the attractions of business life in the towns, to return to their holdings or to acquire others. This is borne out by the number of applications for homesteads with which the Land Department is being called upon to deal. The report on lumbering has also its favourable indications, owing to the increased need of pulp-wood in view of the demand for paper arising from the reduction of supplies from Scandinavia and the total cessation of exports from Germany. There are other satisfactory features, such as the demand for pit-wood and the large orders for lumber which are being received from Great Britain and South Africa. Owing to decreased railway consumption, and the general reduction in industrial activity, the coal output has been reduced. But asbestos and copper-mining show signs of improvement as compared with the early days of the war. In dealing with manufactures the report states that conditions are generally dull, except in those factories which are working on war orders, to which reference has been made in a previous paragraph. Railway conditions are quiet, though on certain lines in the West construction is proceeding.

The Australian Rainfall.—Some interesting particulars of the rainfall of Australia are given in the *Scottish Geographical Magazine*, in an article by Mr. B. C. Walters, who states that the Australian rainfall covers three periods in the year—(*a*) mid-December to mid-April: greatest intensity in the north, maximum effect in February; (*b*) mid-April to mid-August: winter rains, especially in the south-west, maximum in June; (*c*) mid-August to mid-December: relative dryness throughout the continent, maximum dryness in November. The rainfall of the continent swings with the sun, and is associated with the oscillation of the track of the anti-cyclone centres, between 28° and 35° S., whose passage from west to east, according to Dr. W. J. S. Lockyer, is the dominating factor controlling Australian weather, as also that of South Africa and South America in similar latitudes. In the summer, when the anti-cyclones move along their southern course, cyclonic disturbances from the sea affect the northern part of Australia, bringing the rains which follow, though lagging considerably behind the vertical sun. When, on the other hand, the anti-cyclones move along their nothern course, excessive disturbances affect the southern shores of the continent. In both cases the cyclones traverse the sea, which ensures abundant precipitation. The winter rains are especially pronounced in the south-west of Australia, Perth supplying a better example of the seasonal variation than either Adelaide, Melbourne, or Hobart, just as Cape Town excels both East London and Port Elizabeth in this respect. The whole of the western part, south of 20° S., is affected by the winter rains, but in the east this rainy season does not appear in similar latitudes. The dry season of the southern spring seems to be associated with certain temperature conditions, for besides being the time when the winter rains are dying away and the summer rains approaching, it is the period when temperatures over the land are markedly higher than those of the sea, the special dryness of November being accompanied by the maximum difference in air temperature between land and sea. The recent season has been one of unusual drought throughout Australia, and had it not been for the conservation of water—practicable, however, only to a limited degree owing to the prolongation of the drought—to artesian supply, and to the systems of irrigation in partial operation, the distress in the agricultural and pastoral districts would have become much more acute. The present reports are happily encouraging, as there has ensued an abundant rainfall which gives promise of a good season.

Indian Manufactures and the Present Opportunity.—The Indian Government and Indian manufacturers are recognising the need of availing themselves of the opportunities for developing their manufacturing industries afforded by the present condition of affairs, as is shown in the efforts and proposals constantly reported in the Indian press. In the *Pioneer* (Allahabad) attention is drawn, by the secretary of the Upper India Chamber of Commerce in Cawnpore, to the steps taken to induce manufacturers to consider the possibility of supplying the goods hitherto imported from enemy countries, the value of which amounts to £11,304,000, or 9 per cent. of the total imports, and to the action of the Indian Government in collecting samples of these goods and exhibiting them side by side with those of competing Indian manufacture. A writer in *Commerce* (Calcutta) advocates the starting of paper-mills, on account of the closing of German and Austrian sources of supply. From those countries in 1912-13, it is stated, India imported paper, chiefly

of the coarser quality, to the amount of £192,210. Up to now, the writer says, want of capital and of expert directors has militated against any development of the industry; under present circumstances these difficulties ought not to be insuperable. He affirms that India possesses great natural resources in her vast forests, in her great expanse of land covered with grasses suitable for paper pulp, in her excellent railway and canal systems, and in the cheap and intelligent labour obtainable all over the country.

CORRESPONDENCE.

THE DECORATIVE TEXTILE INDUSTRIES AND THE DESIGNER'S RELATION THERETO.

The reader of the paper on the above subject makes misuse of the occasion afforded him by his attack on Schools of Art and their masters. His remarks suggest ignorance of both, and it is with surprise that one reads in his subsequent letter that these "somewhat severe criticisms" were made in the hope that they would not go unchallenged.

May I call attention to an expression by Mr. Bernard Shaw in the discussion on "Shakespeare's Profession," reported on p. 336 of the *Journal*, to the effect that "In any period in which Art was active there were two orbits which never crossed each other. One was the orbit of the man who dealt with an established form of Art and carried it to its highest perfection, always . . . a contemporary form of Art. The other was the orbit of the man who, finding established forms of Art altogether repugnant to him . . . and believing them to be entirely wrong from beginning to end, immediately started on a forlorn hope and tried to turn the public taste upside down."

As to Mr. Wilcock's criticisms, one wonders, seeing he is so unacquainted with the schools, by whom they could be inspired, until he relates his experience of a student of the Royal College of Art some three years ago. It would be interesting to have this student's side of it. One can hardly think that a man who had served his "apprenticeship in the studio of a Manchester printer," and who was clever enough to win a scholarship from the Manchester School of Art to the Royal College of Art, after his term there—even if his "artistic and technical knowledge of cotton-printing had lain fallow during his college days," and "had become obscured by all the varied and perfunctory studies of other industrial arts and crafts"—would be so useless. He certainly would be worth "£5 per week," if given a fair trial.

But from his letter, Mr. Wilcock's quarrel is not with the Royal College of Art only. The schools generally are the object of his attack, as well as their masters, although he asks for credit for a full appreciation of what the schools have done and disclaims abuse. "The design master, a professional architect," can no doubt defend himself from the aspersions cast at him; but the letter to the headmaster certainly seems to require an answer.

As one who has had many years' connection with Schools of Art (London and provincial), as student, teacher, and headmaster, following on a practical training in woven textiles (all branches except dyeing), and who is in full sympathy with the industrial aim in Art instruction, I say emphatically that, if the schools suffer from any one thing, it is just this unreasonable and carping criticism, so frequently levelled at them by those who are not acquainted with them. I would say that the country has much to gain by the multiplying tenfold of its opportunities for artistic education through the Schools of Art.

The Art School is a necessary adjunct to our industrial life, and an essential part of any truly educational system. The factory, the workshop, and the design room will give the worker all he will need of the technical side of his work; but commercial exigencies do not allow of his getting what the schools do afford of artistic study.

The student needs opportunities under guidance for study from Nature and the life, study of historic development and characteristics of styles. The work of the school is rightly elemental and foundational, experimental if you like, and must not be in view of fashion or of passing crazes—the pupil will have enough of that when his days of study are past; but the school is not founded to turn out designers any more than the primary school to turn out ready-made clerks.

Nor will design look after itself as asserted. The School of Art must look after it, and will train the inventive faculties, helped by opportunities in practical craftsmanship such as most schools now afford. Many masters are actual craftsmen, who, so far as painting is concerned, rather practise it as relief from more technical work, than teach as disappointed painters. I know admirable examples of this. And if a student is so enamoured of such work as to seek to find a market for his production, who shall say him nay?

But there is too tardy a recognition of these schools, too restricted a control of their energies. Mr. Wilcock would bring to bear a control that would throttle them completely. Why should trade jealousies militate against artistic development? Yet such is the unfortunate case. Why should not employers, managers, and workmen encourage to the full every effort towards artistic excellence in production? Why should not youth have every opportunity for developing artistic faculties? Every effort is made on the commercial side and also on the technical. Well might the Schools of Art languish and the country take a back seat artistically.

I plead for an extension and an expansion of the Schools of Art rather than a curtailment, as Mr. Wilcock suggests. The minds of our youth need

artistic training: so shall we have a public appreciating artistic productions. How is it that artistic instruction is not part of the work of the primary school? Are the minds of children to develop on commercial and technical lines only? Shall they not have a chance in the artistic direction? It is high time we were more liberal in the matter of artistic opportunity. To curtail these is to cripple ourselves.

There should be a School of Art within reach of all our youth (male and female). They may not all become producers of the artistic, but they may all grow up to be choosers and purchasers, and so will the existence of artistic industry be maintained. If this were so there would be no pandering to the public by the designer, and he would be a man esteemed and valued, his work and ability being understood and appreciated.

Mr. Paulson Townsend says, "It is deplorable that we allow the natural instincts for the beautiful (of the nation) to lie fallow." And herein is the gist of the whole question. It is neglect educationally traceable in the elementary education of the child. Education on commercial lines alone tends to drive out what exists of artistic sympathy. Admirable means are taken by some authorities, the opposite of what Mr. Wilcock suggests; but generally such a policy is obstructed, to our very great loss as a nation. Municipal and State support of this policy is needed. Let us have the artistic educationalist and his ideals, but do not reorganise all the life out of us. The schools have had enough. And let us get out of mechanical ruts, being mindful that the character of a nation may be expressed in its Art.

CLARENCE MAWSON, A.R.C.A. Lond.

[This correspondence must now cease.—ED.]

PATENT LAW REFORM.

In the report of the discussion on Mr. J. W. Gordon's paper on Patent Law Reform, I am represented as having stated that the cost of a German patent was £17, of a British patent £7, and of a United States patent 7*s*. This scarcely conveys the sense of what I said. In comparing the cost of patents in the principal countries of the world, I assumed a patent to be maintained for the full term. I added together the fees on application, grant, and maintenance, divided the sum by the number of years, and thus arrived at the average *annual* cost. A German patent maintained for the full term costs a trifle over £17 per annum, a British patent a trifle over £7 per annum, and a United States 8*s*. 6*d*. Why should a German patent be valued at forty times that of a United States patent? Is a patentee likely to make a sovereign out of his German patent for every sixpence he makes out of his United States patent? If not, why should he pay forty times as much for protection? I do not suggest that no inventions are worth protecting on such exorbitant terms as those exacted by Germany; but as one cannot have different scales of fees for different classes of invention, the scale should be such as not to exclude improvements of utility and merit, although perhaps of moderate industrial importance.

I may be told that, as regards British patents, I should be the last to criticise the scale of renewal fees at present in force, as it was adopted at my suggestion (in 1889). The scale was based on the idea of making the amount of the fee correspond with the year in respect of which it was payable, and to that extent was more convenient than the irregular scale previously in vogue. At that time, however, the main object was to get a substantial reduction in the scale of fees then prevailing, and amounting to £150. The struggle was so far successful that the amount of these fees was reduced from £150 to £95; but I think it would be greatly to the advantage of the community if they were further reduced, and the yearly increment made 10*s*. instead of 20*s*. If this were done, the renewal fees would amount to £47 10*s*.; but if the term of the patent were at the same time extended from fourteen to, say, seventeen years, there would be a further £24 payable. In addition to this, many more patents would be maintained, whilst others would be maintained for longer terms; so that, on the whole, patents would be popularised without entailing any loss of revenue.

Mr. Gordon's remarks on the subject of compulsory licences were of a highly interesting and instructive character, but he did not say much about the revocation of patents for non-working. I am entirely in favour of the compulsory licence as a remedy for obstructiveness, subject to the provision of appropriate means for administering the remedy. It is generally recognised that the machinery provided for giving effect to this provision of the Patents Act of 1907 is unsatisfactory. It is for lawyers to devise means of a workable and effective character, and I hoped that Mr. Gordon would have some suggestions to make on the subject. Many matters of quite as much importance as licences under patents are settled by arbitration, and it might be worth considering whether applications for the grant of compulsory licences could be dealt with by such or similar means. If the compulsory licence idea, which is good in itself, could be worked out in such a manner as to admit of its being put into operation at least as readily as the arbitration clause in any ordinary agreement, the provision for the revocation of patents for non-working would become not only unjustifiable but unnecessary.

We are all agreed as to the desirability of promoting home industries and the employment of native labour; but the grounds upon which a patent may be attacked cannot be extended without rendering patent property more unreliable, and deterring persons from risking capital in the establishment of industries based thereon. If it be desired to encourage the establishment of new industries, everything should be done, not to destroy patents but to facilitate their maintenance. In order to induce a manufacturer to undertake

the labour and pecuniary risk incidental to the establishment of a new industry, one of the first essentials is the existence of a sound patent, on which he may rely for protection for at any rate a limited term. So long as the patent remains in existence there is some chance of manufacture being undertaken under its protection, and if that be the object in view the worst possible course is to destroy the patent.

Our Patent Law might undoubtedly be improved in many respects, to the great advantage of the community, but the subject is not one in which the public manifest any particular interest. There are societies for promoting the welfare of horses, dogs, cats, and other animals; but there is, as far as I am aware, no organisation whose special function it is to promote the interests of inventors and of those who turn inventions to the commercial and industrial advantage of the country at large. I have often hoped that the Royal Society of Arts would see fit to take the lead in this matter. There are many improvements which might be urged, but I will merely summarise the few points I have already touched on:—

(*a*) Reduction in the fees for maintenance by (say) one half.

(*b*) Extension of the term of Letters Patent from 14 to (say) 17 years.

(*c*) Simplification of the machinery for procuring the grant of compulsory licences in cases of non-working.

(*d*) Abolition of revocation for non-working.

(*e*) Extension of the official search as to novelty, so as to render it at least equal to that made in the United States.

G. G. M. Hardingham.

GENERAL NOTES.

Revival of the Bêche-de-Mer Industry in the Bahamas.—Recently a shipment of bêche-de-mer, valued at about £8,000, was made to Chinese ports from the Bahamas, which revives an industry that for a period of forty years promised well. The sea slugs in the waters of the Bahamas appear to be of high quality as compared with those of the East Indies and Australian coast and the atolls of Polynesia. In the south-western section of the Pacific the industry is valued at more than £2,500,000 annually, but the supply seems to be getting limited. It is said to be likely that, with proper selection with reference to size, colour, and correct method of curing, and the facility for shipment through the Panama Canal, the Bahamas may in the near future benefit from an increased demand for this article. Even in Paris bêche-de-mer is served at many restaurants, although the greatest quantity is required for the people of China.

The Greek Fishing Industry.—Fishing is an important industry along the entire coast line of Greece and in the neighbouring waters. The principal fish caught in local waters are the tunny, the sardine, mullet, smelt, gudgeon, mackerel, etc. To a great extent the fish taken by local fishermen are consumed within the country. In addition to the deep-sea fishing, the Government owns some sixty-seven fish-breeding ponds and fishing grounds, both in salt and in fresh waters. The privilege of taking fish from these waters is granted for periods of ten years. Up to 1911 fishing was carried on in local waters in an unsatisfactory manner, and one prejudicial to its best interests. In that year the Government engaged the services of an Italian expert, and established a bureau of fisheries in the Ministry of National Economy. Within the succeeding two years the results achieved by the bureau have been satisfactory. Measures are now taken for the protection of the fish at proper seasons, the kinds of net to be used are prescribed, etc., and provision is made for inspections from time to time by Government inspectors.

Production of Quicksilver in Italy.—The total production of quicksilver in Italy in 1914 amounted to 1,072,629 kilogrammes (2,364,700 English lbs.). This was furnished by the following mining firms and companies:—

	Kilogrammes.
Società anonima Miniere dei Monte Amiata	740,025
Società anonima Stabilimento minerario del Siela	181,332
Eredi Swarzenberg	91,045
Società an. Miniere Cinabrifere Bagni San Filippo	46,220
F. Menicanti	14,007
Total	1,072,629

The Dairy Industry in Switzerland.—A Zurich journal states that there has been a serious decrease in the production of milk during the past winter in many parts of Switzerland. As compared with the similar period in 1913, the falling-off during last January has been very marked in the following cantons: Berne, 28 per cent.; Lucerne, 26 per cent.; Aargau, 25 per cent.; Neuchâtel, 21 per cent.; Friburg and Soleure, 20 per cent.; Thurgau, 18 per cent.; Vaud, 13 per cent.; St. Gall, 12 per cent.; Zurich, 9 per cent.; and Geneva, 2 per cent. In fact, the dairymen of Switzerland have found it difficult to meet the demands of their customers. The federation of dairymen of north-eastern Switzerland, which has been established for the last ten years, comprises 256 separate syndicates as well as 57 independent firms, representing 8,088 members, who own 31,596 milch cows, producing 1918 hectolitres (40,086 gallons) daily. Fresh butter for the table is fetching in many markets as much as 4 francs per kilogramme (1*s.* 6*d.* per lb.). In the German-speaking cantons the prices range between 3 francs and 3·90 francs per kilogramme (1*s.* 3*d.* to 1*s.* 5½*d.* per lb.) at the present time.

THE CREAM-SEPARATOR INDUSTRY IN SWEDEN.—The manufacture and marketing of cream separators has become an important Swedish industry. A factory in Stockholm is one of the largest in the country. Many of these establishments have branch factories and selling agents in almost every country in the world. Statistics for 1913 are not yet available, but the exports for 1911 and 1912 were valued at £750,000 and £770,000 respectively. Russia is the best single market for Swedish cream separators. As in many other articles manufactured in Sweden, the close proximity to Russia gives a decided advantage over other foreign competitors. Germany, before the war, was the next best customer, taking about half as many separators as Russia. This shows that the German home industry in this respect is not as highly developed as it is in England and the United States, which countries, more or less, supply their own needs. One reason for the success of this industry in Sweden is the enterprising methods of many of the manufacturers, who issue splendidly illustrated catalogues, printed in at least four languages. Travelling salesmen and resident agents, furnished with literature of this nature, together with a thorough knowledge of their business, are highly successful in effecting sales.

THE ESSENTIAL OILS OF RÉUNION.—The exports of essential oils from Réunion have of late been steadily increasing. These oils are as follows: Geranium oil, which in 1913 was exported to the extent of 94,600 lbs.; ylang-ylang, or cananga oil, which is derived from the flowers of *Cananga odorata*, and is regarded as one of the most delicious odours in the market. This is also produced in the Philippines. The amount of this essence exported from Réunion in 1913 amounted to over 4,000 lbs., and in future years this quantity is expected to be much exceeded. Veti-vert, derived from the grass *Vetivera zizanoides*, is the most viscid of all the essential oils. The demand for it is not very great, and it is not expected that there will be any increased production in Réunion. The amount exported from the island in 1913 was 4,600 lbs.

RUSSIA'S SURGICAL INSTRUMENTS.—A Russian correspondent of the *Lancet* writes that the problem of the supply of surgical instruments, since importation has become so difficult owing to the war, is being partly solved by the Russian cottage or home industrialists, particularly in the village of Pavloff, in the Nishegorod government. The peasant workers there have delivered various surgical instruments of such quality as to convince local traders that not only German, but foreign goods generally of the kind, can now be dispensed with. One large Moscow house that specialises in these goods is establishing a workshop of its own at Pavloff, and is opening there a bureau for giving cash advances to peasants who have devoted special attention to the making of surgical instruments. Instruments received from Sweden are of high quality, but expensive. A parcel of excellent instruments has been received from Japan at the Soldatenkoff Hospital, Moscow, and similar consignments are expected from England *viâ* Copenhagen.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock (except where otherwise announced) :—

MARCH 24, at 5.30 p.m.* — LADY LUGARD, "The Work of the War Refugees' Committee." COLONEL SIR THOMAS H. HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Chairman of the Council, will preside.

APRIL 14. — T. THORNE BAKER, "The Industrial Uses of Radium."

APRIL 21.—MORETON FREWEN, "The State and the Fisherman."

APRIL 28.—A. S. E. ACKERMANN, B.Sc., Assoc. M.Inst.C.E., "The Utilisation of Solar Energy."

MAY 5. — AUGUSTUS VERNON HARCOURT, D.C.L., LL.D., D.Sc., F.R.S., "On an Economical and Smokeless Grate, and on the Measurement of the Efficiency of Open Grates."

INDIAN SECTION.

Thursday afternoons :—

APRIL 15, at 5 p.m. — PERCEVAL LANDON, "Basra and the Shatt-ul-Arab." The RIGHT HON. EARL CURZON OF KEDLESTON, G.C.S.I., G.C.I.E., will preside.

MR. M. M. S. GUBBAY, I.C.S., having been recalled to duty by the Government of India, will be unable to read the paper on "Indian Trade and the War," which was announced for May 13th.

COLONIAL SECTION.

Tuesday afternoon, at 4.30 o'clock :—

MAY 4.—S. CHAS. PHILLIPS, M.S.C.I., "The Empire's Resources in Paper-making Materials." The HON. SIR GEORGE H. PERLEY, K.C.M.G., Acting High Commissioner for Canada, will preside.

Dates to be hereafter announced :—

C. H. SHERRILL, "Ancient Stained Glass."

CHARLES R. DARLING, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

* The hour of this meeting has been changed from 4.30 p.m. to 5.30 p.m.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

M. H. BAILLIE SCOTT, "House Building: Past and Present." Three Lectures.

Syllabus.

LECTURE II.—MARCH 22.—*Houses in the Past in this Country.* Three main periods: (1) The craftsman or mediæval period, when the art of building flourished; (2) The scholar, or Renaissance period, when the building art became "tongue-tied by authority"; (3) The shopkeeper, or commercial period—The distinguishing features of the three periods set forth as an allegory—The trades guilds—The spirit and methods of the old craftsmen—The scholar spirit—The commercial spirit.

LECTURE III. — MARCH 29. — *Houses of the Present.* The average house of the craftsman period adorned the world—The average modern house disfigures the world—Normal modern building a disease rather than an art—The causes and cure of this disease—Difficulties of the architect—Building by-laws—The qualities of various types of houses discussed—An ideal house described.

DAVID SOMMERVILLE, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 22 ..ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. M. H. Baillie Scott, "House Building: Past and Present." (Lecture II.)

East India Association, Caxton Hall, Westminster, S.W., 4 p.m. Mr. E. B. Havell, "The Foundation of Indian Economics."

Geographical Society, Burlington - gardens, W., 8.30 p.m. Dr. W. S. Bruce, "Spitsbergen in 1914."

Architectural Association, 18, Tufton-street, S.W., 8 p.m. Mr. Hilaire Belloc, "The Changes in the Conception of Artificial Permanent Defence, including those indicated by the Present Campaign."

TUESDAY, MARCH 23...Sociological Society, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 5.15 p.m. Sir T. Barclay, "The Hague Tribunal: its Constitution and Potentialities."

Royal Institution, Albemarle-street, W., 3 p.m. Professor Sir J. G. Frazer, "The Belief in Immortality among the Polynesians." (Lecture II.)

Civil Engineers, Institution of, Great George-street, S.W., 8 p.m. 1. Discussion on Sir T. Mason's paper, "The Improvement of the River Clyde and Harbour of Glasgow, 1873-1914." 2 Mr. C. W. Anderson, "On Impact Coefficients for Railway Girders."

Photographic Society, 35, Russell-square, W.C., 8 p.m. Mr. A. E. Morton, "Our Cottage Homes."

Zoological Society, Regent's-park, N.W., 8.30 p.m. 1. Mr. W. R. Ogilvie-Grant, "Exhibition of Partridges and other Game Birds." 2. Dr. F. E. Beddard, "Contributions to the Anatomy and Systematic Arrangement of the Cestoidea. XVI. —On Certain Points in the Anatomy of the Genus *Amabilia* and of *Dasyurotænia.*" 3. Mr. R. Lydekker, "The True Coracoid." 4. Mr. J. T. Cunningham, "The Artificial Formation from Paraffin-Wax of Structures resembling Molluscan Shells." 5. Mr. B. F. Cummings, "On Two new Species of *Polyplax* (Anoplura) from Egypt."

Electrical Engineers, Institution of (Local Section), 17, Albert-square, Manchester, 7.30 p.m. Mr. W. R. Cooper, "Electric Cooking, mainly from the Consumer's Point of View."

WEDNESDAY, MARCH 24...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., **5.30** p.m. Lady Lugard, "The Work of the War Refugees' Committee."

Naval Architects, Institution of, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 11 a.m. (Annual Meeting.) 1. Presidential Address. 2. Professor J. J. Welch, "The Watertight Subdivision of Ships." 3. Mr. K. G. Finlay, "The Increase of Safety Afforded by a Watertight Deck." 3 p.m. 1. Mr. J. Reid, "The Influence of Discharging Appliances on the Design of Large Ore-Carriers." 2. Mr. J. Montgomerie, "The Scantlings of Light Superstructures." 3. Mr. C. F. Holt, "On the Strength and Spacing of Transverse Frames."

Literature, Royal Society of, 20, Hanover-square, W., 5 p.m. Mr. P. H. Newman, "The Greek Trireme, with some remarks on Ancient Sea Power and Theories of Propulsion."

Royal Archæological Institute, at the Society of Antiquaries, Burlington House, W., 4.30 p.m Mr. I. C. Hannah, "Some Irish Religious Houses."

THURSDAY, MARCH 25...Naval Architects, Institution of, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 11 a.m 1. Mr. F. W. Lanchester, "A Contribution to the Theory of Propulsion and the Screw Propeller." 2. Mr. A. W. Johns, "A Comparison between the Results of Propeller Experiments in Air and Water." 3. Mr. J. L. Kent, "Further Model Experiments on the Resistance of Mercantile Ship Forms: The Influence of Length and Prismatic Coefficients on the Resistance of Ships."
3 p.m. 1. Mr. C. E. Stromeyer, "The Law of Fatigue Applied to Crankshaft Failures." 2. Mr. Linton Hope, "The Effect of Beam on the Speed of Hydro-Aeroplanes." 3. Mr. E. F. Spanner, "Notes on the Cross Curves and GZ Curves of Stability."

Royal Society, Burlington House, W., 4.30 p.m.

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Child Study Society, at the Royal Sanitary Institute, 90, Buckingham Palace-road, S.W., 6 p.m. Mr. C. E. Wallis, "The Care of the Teeth."
7.30 p.m. Annual Meeting.

Royal Institution, Albemarle-street, W., 3 p.m. Dr. A. Strahan, "The Ground beneath London."

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mr. M. W. Brockwell, "The Present War, and its Relation to the Art History of Western Europe."

Electrical Engineers, Institution of, Victoria-embankment, W.C., 8 p.m. Mr. W. L. Preece "Telephone Troubles in the Tropics."

FRIDAY, MARCH 26...Royal Institution, Albemarle-street, W., 9 p.m. Professor Sir J. J. Thomson, "Experiments in Slow Cathode Rays."

Geologists' Association, University College, W.C., 8 p.m.

Physical Society, Imperial College of Science, South Kensington, S.W., 5 p.m.

SATURDAY, MARCH 27...Royal Institution, Albemarle-street, W., 3 p.m. Professor Sir J. J. Thomson, "Recent Researches on Atoms and Ions." (Lecture VI.)

Journal of the Royal Society of Arts.

No. 3,253. VOL. LXIII.

FRIDAY, MARCH 26, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MARCH 29th, 8 p.m. (Cantor Lecture.) M. H. BAILLIE SCOTT, "House Building: Past and Present." (Lecture III.)

CANTOR LECTURES.

On Monday evening, March 22nd, Mr. M. H. BAILLIE SCOTT delivered the second lecture of his course on "House Building: Past and Present."

The lectures will be published in the *Journal* during the summer recess.

PROCEEDINGS OF THE SOCIETY.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 24th, 1915; COLONEL SIR THOMAS HUNGERFORD HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Vice-President and Chairman of the Council of the Society, in the chair.

The following candidates were proposed for election as Fellows of the Society:—

MacCaw, Vivian Hardy, 21, Strand-road, Calcutta, India.

Pardiwalla, Jehangir Pestonjee, Hotel Majestic, Bombay, India.

Saunders, Alfred Oliver, 102, Osborn-road, Sparkhill, Birmingham.

Spence, Charles Stewart Traill, Plantation Waterloo, Nickerie, Surinam, Dutch Guiana.

The following candidates were balloted for and duly elected Fellows of the Society:—

Baltimore, Professor Jeremiah D., Armstrong Technical High School, Washington, D.C., U.S.A.

Murphy, Joseph Plato, Zorgenhoop, West Bank, Berbice, British Guiana.

The paper read was—

THE WORK OF THE WAR REFUGEES' COMMITTEE.

By LADY LUGARD.

I have been asked to speak to-day about the work of the War Refugees' Committee.

The work of the War Refugees' Committee is intimately associated with what will, I believe, hereafter be regarded as one of the most acutely pathetic chapters of our island history. Because we are an island, because a stretch of sea lies between us and Europe, because, above all, we have a Navy which for a thousand years has known how to defend that strip of sea, we have been able, not for the first time in our history, to offer refuge to a people stricken and driven out from their proper home.

There is no need for me to speak now of what Belgium has done—we all have the knowledge in our hearts. In the Titanic struggle in which we are engaged Belgium bore for a time the burden of the world, and the world can never forget, and never repay.

We all remember the shock of horror with which we read the first accounts of the atrocities perpetrated at Visé and Liége. But we have almost forgotten that only a few days before the outbreak of this war our eyes were turned towards another theatre of disturbance, and the outbreak of civil war in Ireland was the catastrophe we feared. For a moment I must recall it in connection with the refugees, for, strange as it may seem, the War Refugees' Committee is, in a sense, the lineal descendant of the Ulster Council.

The preparations of Ulster in the early summer of last year were sufficiently public to be known to anyone who chose to be acquainted with them. Like most Irish Protestants, I was aware that in view of coming contingencies arrangements had been made for the removal of many thousands of women and children from the area which was likely to become a theatre of war.

These arrangements had been made with great thoroughness. Registration and all other necessary forms had been prepared, transport had been organised, and safe homes had been secured in England. The outbreak of European war mercifully averted the misfortune of war in Ireland, and when the news of the first atrocities came through from Belgium they suggested the idea, "Why not use the Ulster organisation to get the Belgian women and children out, if possible, from under the German guns?" At that time we had, of course, no conception of the development which the refugee movement was ultimately to take. The thought in my mind was mainly of women and children. I telegraphed to Captain Craig to ask whether, if such a scheme proved feasible, he would let me have the use of the Ulster organisation. He telegraphed back immediately that everything they had was at my disposal for such a purpose. He sent me all their registration forms—forms which we are to-day using at the War Refugees' Committee—and put me immediately in touch with people who had the necessary information. In twenty-four hours I had the embryo of an organisation in my hands.

But it was evidently necessary to change what I may call the "sentiment base." The next step was to approach the Catholic Church and to ask of Cardinal Bourne that the Catholic institutions of Great Britain and Ireland might be circularised in order to ascertain how many homes of undoubted security could be placed at the disposal of Belgian refugees. I was received with a cordiality which, I would like to say here once for all, the Catholic Church has constantly maintained towards the movement. I was assured by Monsignor Bidwell, whom Cardinal Bourne deputed to discuss the matter with me, that assuming the movement to be properly organised and to be viewed with favour by the Government, the Catholic authorities would be very ready to help.

With this amount of preparation I approached the Foreign Office, and was assured of the sympathy of Sir Edward Grey. The Local Government Board signified their approval, and the Foreign Office was good enough ultimately to arrange an interview for me with the Belgian Minister, directing me that in placing the scheme before him I was to inquire what steps his Government, in the event of their viewing the proposal with favour, would take to make the scheme known in Belgium. In accordance with these instructions I laid the scheme before the Comte de Lalaing, and in due course an answer was received from the Belgian Government accepting the proposal with gratitude, and saying that they would make the scheme known in Belgium, and would direct intending refugees to come to Ostend, whence it was understood that we would take steps to bring them away.

While these negotiations were in progress the position in Belgium was becoming every day more acute, and on a certain Saturday, August 22nd, I was informed by Mr. Reyntiens and Mr. Wintour, of the Board of Trade, that they had the promise of a transport from the Admiralty, with which they were immediately going to fetch over refugees, and that they hoped to return on the following Monday with a ship-load. I asked Mr. Reyntiens how many they proposed to bring back. He said, "As many as we can get—anything from 100 to 1,000." To the inquiry, "What do you propose to do with your refugees when you bring them back?" his reply was, in effect, "We leave that to you!" There was no time to discuss the matter; it was necessary for him to go at once and get his papers ready, and I was left on Saturday morning in full sympathy with the adventure, but with the knowledge that on Monday I might be expected to receive in England 1,000 refugees.

No committee had as yet been formed. It was evident that between Saturday and Monday a committee had to be formed. I will not delay you with a relation of the details of that Saturday and Sunday afternoon, interesting as they were at the moment to those engaged in the work. The only condition which I made was that the committee should have no politics and no religious distinctions, and it is enough now to say that, thanks mainly to the exertions of Mrs. Alfred Lyttelton and Mr. H. E. Morgan, a committee was formed under the required conditions and in the required time, Lord Hugh Cecil consenting to be our chairman and Lord Gladstone our treasurer.

By the kindness of Mr. F. Norie-Miller, General Manager of the General Accident Fire and Life Assurance Corporation, Ltd., offices were placed at our disposal entirely free of charge. The embryo of a clerical and typewriting staff was secured. A name was chosen. An appeal was sent to the papers on Sunday night, and as a net result of our exertions we were enabled on the following Monday morning to take possession as a committee of the empty offices which have since developed into the well-known headquarters of the War Refugees' Committee at Aldwych. That first morning we had hardly pens and ink, we had not chairs to

sit upon, the offices were almost entirely without furniture, and while we were trying to organise our immediate plan of operations the response to our appeal, which had appeared only in that morning's papers, took the embarrassing, if at the same time encouraging, form of no less than 1,000 letters, all containing offers of hospitality and help.

The response of the country to the movement was absolutely extraordinary. The 1,000 letters of that day became 2,000 on the following day, then 3,000, then 4,000, then 5,000, and on the day on which we received 5,000 letters there were also 1,200 callers at the office. Every letter and every visitor brought proposals of help in one form or another. Within a fortnight we had at our disposal hospitality for 100,000 persons. Cheques, clothing, food, offers of personal service, flowed in upon us. I could spend hours rather than minutes in telling you the details of that first outpouring of public generosity. The sense of the country was made absolutely clear that, if it could not share the acute suffering caused to the people of Belgium by the war, it desired to diminish that suffering by every means that it possessed. These offers came not from one class nor from one place, but from all classes and from all places. Catholic and Protestant, Jew and Nonconformist, high and low, rich and poor united, all unaware, in a spontaneous tribute of sympathy and respect. Nations, like individuals, have their moments of unconscious self-revelation. It was a moment which unmistakably revealed the heart of England.

The enthusiasm and volume of the movement were cheering. They brought with them accompaniments which it must be admitted were difficult to cope with. We were soon accused, and justly accused, of not answering our letters, of not acknowledging our cheques, of not receiving our visitors with due consideration. It was all true! To have done otherwise was a physical impossibility, for what were we among so many? We were only a willing company of amateurs suddenly called upon to deal with the conditions of a large business created in three days. And while this volume of external business was pouring in, the true object of our existence remained, in our opinion, the providing of homes for our coming guests. We contented ourselves with locking up our cheques, and gave our thoughts to the refugees.

They began to come in the first day. They increased in numbers, not being immediately brought in shiploads, but trickling through on their own account from various sources to the number of perhaps 100 or 150 a day. Our first difficulty with regard to finding homes for them was met by the kindness of Sir James Dunlop-Smith, who obtained from the India Office permission to place at our disposal a small house at 49, St. George's Road, usually occupied by the King's orderlies, but standing at the moment empty and furnished. This was the first place of refuge offered in this country to Belgians. It seemed to us a suitable coincidence that it should come, even indirectly, from the King. The Borough Council of Camberwell was, if my memory serves me, the next to offer us beds for Belgian refugees. They had organised Dulwich Baths as a hospital, and they placed at our disposal between fifty and one hundred beds. Battersea followed their example. Private offers were added to these, and in two or three days we had a couple of hundred beds upon which we could count.

We reached the third day of our existence before any news came of the shipload of refugees for whose reception the Committee had been so hastily organised. It was on Wednesday evening, at about half-past seven o'clock, as we were separating after a heavy day's work, that a telegram was brought in saying, "One thousand refugees arriving Folkestone to-night. Can you take 500 in London to-morr[illegible] The moment had come. We had provided with the greatest difficulty for 250. To provide suddenly for 500 more seemed at first sight impossible. But to give you one instance of the early work I will describe how it was done.

Among the offers which had been made to us was one from the Army and Navy Stores, proposing to lend us an empty shirt factory conveniently situated just opposite Victoria Station. It was in a perfectly sanitary condition, clean, with gas, light and water laid on, but stark empty. At eight o'clock on Wednesday evening we accepted the offer. Mrs. Walter Cave took direction in this particular act of energy, and I believe she was up all that night. The Army and Navy Stores let us have beds at cost price. The chairman of the Rowton Houses lent us crockery and linen. Willing help came from every side, and the result was achieved that before three on the following afternoon the shirt factory had been converted into a hostel where 250 beds were made up with clean sheets and pillow-cases, a kitchen was arranged downstairs with eight cooking-stoves, dining-tables were ready laid, and a hot dinner for several hundred people awaited the arrival of the

refugees. Our first batch of 250 arrived there that afternoon. We disposed of the others in different places, and from that day, though we continued to receive refugees in London at the rate of several hundreds per day, and were often at our wits' end what to do, not one who reached our hands was ever left without food and lodging.

The experience of this first week gave us the formation of the principal departments of the War Refugees' Committee. I do not propose now to detain you with any full description of our organisation. For anyone who is interested the details are recorded in the Blue-book issued by the Departmental Committee appointed by the President of the Local Government Board to consider and report on questions arising in connection with the reception and employment of the Belgian refugees in this country. I will indicate merely the framework of the machine which circumstances immediately brought into operation.

Our first need was obviously a Card Index and Correspondence Department. This department has since been placed under the very efficient management of Mr. Arthur Chadwick, and with the Cashier's Department, under our excellent cashier, Mr. Bourne, has completely rescued us from the reproaches of the first days.

We needed a Transport Department to meet refugees at the stations to convey them to and from the refuges. Under Mr. Henry Campbell, of the London General Omnibus Company, this department has become one of the most important and efficient branches of our practical organisation. Mr. Campbell's grip and comprehension of the work of the War Refugees' Committee is so complete that I believe if the whole Committee were swept away and he left standing the work would still be satisfactorily carried on.

Our next obvious need was an organised system of fitting the refugees into the offers of hospitality which were received for them. This has remained from the beginning the most complicated and difficult work we have had to do. A department, afterwards known as our Allocation Department, was organised at once under Lady Gladstone, Mrs. Alfred Lyttelton and Mrs. Gilbert Samuel, who have been assisted in the work by an army of willing volunteers. The work of this department, of which a beginning had been made in the Belgian Consulate Room even before the War Refugees' Committee came into existence, has since been carried on in four main divisions. There has been our Central Allocation Department, of which the direction has remained in the hands of Mrs. Gilbert Samuel. There has been a very important development of subsidiary branches in the Rink under Mrs. Alfred Lyttelton. There has been the allocation of the Belgian Consulate, also carried on at Aldwych under the direction of the Misses Rothschild and a group of helpers, and there has been the allocation of the Catholic Women's League, under the direction of Miss Streeter, working always in co-operation with Aldwych, but carried on from their own headquarters in Victoria Street. In addition to these there has been also the allocation, carried on independently of Aldwych, by the Jewish community, who from their own private offers have provided for upwards of 6,000 people. The Catholic ladies have also allocated upwards of 6,000. In the Misses Rothschilds' room at Aldwych, some 30,000 have been provided for. Our own two branches of allocation have since the beginning of the movement arranged for the placing of between 50,000 and 60,000 persons. In all, the War Refugees' Committee have found homes for 100,000 persons.

A department separate from the Allocation Department proper, but taking its rise in the same necessities, is the Department of Local Committees, which early in the movement formed themselves throughout the country for the better management of local offers of hospitality, while working in correspondence with Aldwych. This department at Aldwych has been from the beginning under the supervision of Lord Lytton, who has directed it with an ability and devotion for which the War Refugees' Committee have every reason to be grateful. The number of local committees with which his department maintains touch is now nearly 2,000.

To these departments one other of great importance was added in the first days. It was our Clothing Department, with headquarters at 23, Warwick Square. Here Lady Emmott, ably assisted by Lady MacDonnell and other devoted ladies, has been enabled by the generosity of the public to distribute nearly a million garments, including much-needed boots and shoes.

The creation of our different departments was, as I have said, immediately imposed upon us by the conditions of the problem with which we were dealing. The general work of direction and co-ordination, and the creation of new means of meeting each new necessity of the situation, had also to grow from the simple beginnings of the early days. It was soon found that it was desirable to place the management

under one direction, and it was decided to ask Lord Gladstone—who was prepared to give the time and devotion necessary to such a work—to accept a position which is, I suppose, equivalent to that usually held in a commercial company by the managing director. Mr. Morgan was at first associated in this direction, but found himself afterwards unable to devote the necessary time, and Lord Gladstone has from the beginning borne the brunt of the central work of the Committee. It is only in a later chapter, to which I shall have occasion to refer, that he has been assisted in a Management Committee by Lord Lytton and the Right Hon. W. H. Dickinson, M.P. Lord Gladstone's work has been no sinecure, and we all, if I may be permitted to say it, give ungrudging recognition to the absolute sincerity and unselfishness of purpose with which he has pursued it. We do not claim as a Committee—and I am sure Lord Gladstone would heartily agree with me—to have been perfectly organised or perfectly directed, or that our staff, amounting at one time to upwards of 500 devoted volunteers, have always perfectly understood or perfectly carried out the intentions and instructions of headquarters. We are willing to accept in a chastened spirit all reasonable criticism. The only claim we are concerned to make is that the War Refugees' Committee throughout has been a willing instrument. In ourselves we have been nothing. The power by which we have been worked has been the country. We are proud only to have been privileged to represent a movement which may claim to take its place in history as the consolation of a nation by a nation.

It is as a task of consolation that we have from the beginning conceived of our work. I regret to have detained you so long with a description of the machinery by which the work was done. I take you back now to the days when the first refugees, fleeing from the terror of fire and sword, began to reach our shores. These refugees were different from the refugees who are now arriving. They had actually borne the first onslaught of German fury. Men had seen their wives and daughters shot, and worse than shot, before their eyes. Fathers and mothers had seen their little children trampled to death under German feet. Old and young had alike been driven before the bayonet and placed as shields to protect the enemy from Belgian bullets. Some had been forced to dig graves, and even to bury men who were not yet dead. All had been smoked and burned out of their pillaged homes, holding themselves lucky if they were not forced back to be consumed in the funeral pyres of their domestic possessions. It has become the fashion now to cast doubt upon the authenticity of deeds fit only for the annals of the Middle Ages. Those of us who helped at that time nightly to receive the refugees as they arrived can never forget the tales of inconceivable horror which were poured into our ears, nor the convincing simplicity of narration which made it impossible to doubt their general truth. I remember the first refugee with whom I happened to speak about herself. It was not a horrible case—on the contrary, quite simple, but it brought home to me with a shock of realisation what was happening within an ordinary day's journey of London. It was only a mother feeding her child with a basin of bread and milk in one of our refuges. I asked her where she came from. She said, "Charleroi." "Then you have seen the fighting?" "Oh, yes; I carried him"—indicating the baby—"out under the German guns." It was nothing. She had had the luck to escape, but the contrast between the peacefulness of her actual occupation and her words brought home what she had escaped from. In the same refuge on a later day there was a man whose face was like the face of a tragic fate. He did not speak—he did not move. The ladies who were working in the refuge approached him for some time in vain. One reminded him that he had his wife while many had lost their wives, and at last he spoke. "Yes," he said, "I have my wife! But we had five children, and we have not one left. Four of the little ones were trampled to death under the feet of a German regiment, and my little girl, my eldest, fourteen years old, was given to the German soldiery, who misused her before my eyes. Afterwards they took her away with the regiment." And he fell back to the only thing he seemed able to say: "We had five children—we have not one left." The stories which we heard at that time daily and nightly, from not one alone, but from practically every refugee who reached us were such as surpass all imagination of horror and brutality. We heard them—we became in a sense accustomed to hearing them—but the details of many were such as I could not possibly repeat in a public assembly such as this. An observant friend who accompanied me one day to a refuge said, as we came out: "These people look as if they had all seen ghosts." They had seen ghosts! They had seen spectres of carnage, cruelty, lust and brutality—such evil spirits as, thank God, are not often let loose upon the face

of earth. You will readily understand that to us who were with them at that time, who heard these stories every day, no extenuation of German conduct which can ever be produced will efface the impression that these awful things were literally true. It was also abundantly evident that they were not the isolated acts of brutal or drunken individuals. Evidence was unanimous, and to our minds conclusive, that the crimes were committed in pursuance of a general order from above.

I will not hold your imagination in this atmosphere. Let it be placed to the credit of twentieth-century civilisation that the universal abhorrence aroused by the conduct of the German Army towards civilians was such as to force German authorities to a recognition of the mistake they had committed. Orders to terrorise the population were apparently withdrawn, and so far as we are aware the brutalities of the first weeks of the campaign have for the present ceased.

It was on August 24th that the War Refugees' Committee received its first refugees. Until September 9th they were received, as I have told you, in our own refuges, where we tried to make them as comfortable as we could. Some little difficulty and hesitation existed at first as to the question of facilitating the transport of refugees from Belgium. But this and all other doubt upon the matter was set at rest by the public offer of the hospitality of the nation which was made, as you will remember, by the Prime Minister in the House of Commons on September 9th. From that day the Government has stood behind the movement, and the War Refugees' Committee has worked in close and friendly relation with the Local Government Board.

The first chapter of Government intervention was to relieve the War Refugees' Committee of the expense and difficulty of providing refuges in London. The Government took the Alexandra Palace, and in that and other available public institutions it organised, under the Metropolitan Asylums Board and the Boards of Guardians, refuges which had a total capacity of about 6,000 persons. After the fall of Antwerp Earl's Court camp, with a further capacity of 4,000 persons, was added to the Government refuges. Up to the middle of September the War Refugees' Committee had had difficulty in receiving as many as 500 a day. Since that time, so far as the great majority, which consisted of working-class refugees, are concerned, the War Refugees' Committee has been relieved of anxiety. The first needs of shelter and food were supplied, and admirably supplied, by the Government refuges. I should like, in passing, to offer my tribute of praise to the splendid work done by the officials alike of the Metropolitan Asylums Board and the Boards of Guardians. I was for many weeks in close relation day and night with what was being done, and I can speak from personal observation of the devoted zeal, the kindness of heart, and the untiring industry with which the work of receiving, housing and feeding the refugees was carried out.

The organisation of the Alexandra Palace, where, at first, about 1,500 were received, may be taken as a sample of the rest. The Alexandra Palace, as you know, is a large glass building originally intended for public recreation and conveniently situated in its own grounds on a hill overlooking the north of London. Its central halls, with their merry-go-rounds and swing-boats, lent themselves readily to the reception of refugees, and in the early days visitors who went to condole with the victims of tragic misfortune were usually saluted with shouts of delight proceeding from children profiting, with all the unconsciousness of their age, by the unusual opportunities of enjoyment. The glass roofs of the building admitted sunshine to every corner. One of the central halls was converted into a great dining-room, where sufficient and comfortable meals were served with order and regularity. Beyond the dining-room there was a nursery and hospital, bright with white beds and flowers. Beyond the hospital a large hall has been converted into a bathroom with curtained cubicles, where upwards of 100 baths, fitted with hot and cold water, are at the disposal of the refugees. Another large room was used as a schoolroom and kindergarten for the children. The many rooms surrounding the central halls were converted into dormitories holding each from sixty to 100 beds. In one room the beds had pink coverings, in the next they had blue. Screens covered with chintz gave a certain privacy to groups of beds. Crucifixes were fixed upon the walls. There were lace curtains in the windows. A cinema theatre was converted into a chapel. Large rooms were set aside for workrooms and the distribution of clothing. These were the arrangements made before the fall of Antwerp for the general mass of refugees. Upstairs, in a more private wing of the building, there was accommodation, with a comfortably-furnished sitting-room and dining-room, for about 100

persons who might for any reason on their first arrival be distinguished from the ordinary crowd. Before the fall of Antwerp, since which period the rush of refugees has caused too great a pressure of over-crowding, there was a grace, almost a certain charm, in the arrangements.

Alexandra Palace was, of course, only one place. The spirit which dictated its organisation presided also over the organisation of the other refuges.

The first refugees arrived usually in a state of absolute destitution. Their constant prayer was that they might be immediately allowed to work and to earn for themselves some portion back of what they had lost. But an opinion was at that time held that no attempt should be made to obtain employment for these refugees in the ordinary labour market of the country, and the lavish hospitality which was offered to them encouraged the hope that they might be amply provided for by private beneficence during the continuance of the war.

The first work of the War Refugees' Committee when the refugees arrived in the Government refuges was, therefore, to supply them, as far as possible, with immediate necessaries. They needed everything. Besides the substantial necessaries of clothes and shoes, they wanted combs, brushes, soap, hairpins, bootlaces braces, needles, cotton, thimbles—everything that even the poorest find necessary in daily life. The men, of course, urgently needed tobacco, the women wanted knitting-needles and wool to knit. We did our best to supply all these, and among the small articles which at that time were distributed freely none were more eagerly accepted than rosaries. We gave them away by thousands. The exodus had been so sudden that they had apparently in many cases been left behind, and men and women alike among the first arrivals from the Walloon country seemed anxious to possess themselves of this usual accompaniment of prayer.

There are subjects about which one hesitates to speak in public, yet I would like just to place on record the impression we received from these first refugees of simple faith. They seemed themselves to realise, in the tragic extremity of their distress, that they had lost everything except their God, and I cannot easily convey the touching fervour of the prayers in the chapels of the refuges at which I once or twice incidentally assisted. Piety, courage, extraordinary fortitude, and overflowing heartfelt gratitude for all that was being done for them in England were the principal characteristics that enlisted our sympathy and admiration for our guests.

I know it may be said that the heroic note has not been consistently sustained. That is only to say that human nature remains human in all circumstances. And I would ask, if Oxford had suffered the fate of Louvain, if Canterbury had been destroyed instead of Rheims, if Manchester or Birmingham or Leeds had been bombarded and their population driven out homeless and penniless to foreign shores, do you believe that the whole exodus would have been an exodus of heroes? From the days of Israel onward some members of every great migration have been found to murmur and to cry for quails as well as manna in the desert. None grieve for this occasional backsliding more sincerely than the majority of the better-disposed Belgians themselves. I only wish to bear testimony to the other side, which I have myself seen and admired, of patient and even magnificent endurance.

The refugees were only supposed to remain in the London refuges for a period of three to five days at the outside. Once rested and refitted, it was the work of the War Refugees' Committee to pass them on to the permanent homes so cordially offered by the hospitality of the country. It was in these homes their real reception awaited them, and in these that was prepared for them by the kindness of individual English hearts the "haven where they would be." With what happened after they left our hands we had, of course, little or nothing to do. Everyone gave to his own guests according to the fullness of his means. We received many letters of enthusiastic thanks, expressing the content and joy of the refugees, but our business was only to organise the passing of the refugees from the London refuges to their homes.

The brunt of this work fell, of course, on our Allocation Department, which, as the pressure grew more and more acute through the months of September and October, was obliged steadily to increase its forces. It employed at one time upwards of 100 volunteers. The work of these ladies and gentlemen consisted in receiving from the Correspondence Department overnight cards upon which the offers of hospitality made to the Committee were indexed. With the cards they went on the following day into the refuges, and subsequently into hotels in which better-class refugees were housed, and their object was—acting with as much tact and sympathy as possible—to find from the information given on the cards the most suitable accommodation

for the many differing parties of refugees who presented themselves. At the beginning of the movement refugees had to be dealt with only at the rate of 100 or 200 per day. From the date of the public offer of national hospitality made by the Government the number increased steadily until, during the rush created by the fall of Antwerp, which marked the maximum pressure of the movement, it became necessary for the Allocation Department to deal with upwards of 2,000 persons every day. It is difficult for the public to realise the magnitude of the task thus performed. It involved not only the delicate personal decisions which had to be made by each individual allocator, but it carried with it all the complicated arrangements of registration, transport and warning of hosts. All four branches of the Allocation Department were at this time worked to their utmost.

The arrangements for transport of these separate branches fell upon the Transport Department. Every refugee who arrived from the Continent had to be met and taken to a refuge or a hotel. Every refugee who had left one of the refuges or a hotel to take up the hospitality allotted to him in the country had to be provided with a pass over the railway, had to be convoyed to the railway station, and his host had to be warned at what hour and at what station he was to be received. During the stress created by the fall of Antwerp—when upwards of 4,000 refugees arrived in one day by trainloads from the Continent, and as many as 2,000 had to be sent in small individual groups to different stations of the British Isles—a total of 6,000 had to be handled every day. No warning nor preparation could be given as to the numbers to be dealt with. While the crisis lasted they poured in day and night, taxing the energies of the whole organisation almost to breaking-point. Not only Transport and Allocation, but Clothing, Correspondence and Local Committees were heavily worked. They bore the strain. There was no breakdown. We were able to meet and deal with the crisis. It may readily be imagined that in work of a delicate nature accomplished under such pressure some mistakes were inevitable. But we worked with the consoling thought present to our minds that, if the public could have realised the conditions under which the work was done, it would have been surprised rather at the few than at the many errors into which we fell.

The fall of Antwerp brought us to a new chapter of our work, of which I would have much to say, but that I have already kept you longer than I would have wished. I must touch only as briefly as possible on the aspects of the questions which now present themselves.

The crisis lasted only a couple of weeks. The occupation of Ostend by the Germans on October 17th closed the Belgian coast and stopped the daily transport service. Since that time refugees have been only able to reach us by way of Holland, and though this country has continued to provide such facilities as are possible for their transit the figures of the daily arrivals have fallen considerably. The total for November was the lowest for any month since the beginning of the war. In December and January the numbers again mounted, giving a total of 12,000 for December and 14,000 for January. Refugees are still, notwithstanding the dangers of mines and submarines, and the prohibition of our blockade zone, arriving in numbers which are to be counted daily in three figures. But the rush is over. We are no longer working under the same conditions of pressure.

There are noticeable also some other remarkable differences. We are working now with a different class of refugee. The simple country folk of the first exodus have given place to the urban population of the great towns, and they come to us under different conditions. The early refugees had, as I have told you, suffered in their own persons all the worst horrors of war. Since the fall of Antwerp the flight has been rather—though not, of course, wholly—from "the wrath to come." Many refugees are fleeing from what they fear may happen rather than from what has actually happened. I speak chiefly for the moment of the working-classes. Many of those now coming have been attracted to this country by the accounts sent back in the first moments of relief and gratitude by the earlier refugees. In the refuges and hostels we saw many of the postcards written by the first refugees, and they represented this country and people as something so near Paradise and the angels that expectation based upon such description could hardly fail of disappointment. It need not, therefore, be a matter of surprise if some difference is observable between the attitude and tone of the refugees housed in the Government refuges to-day, and those with whom the same refuges were filled in the earlier stages of the movement.

The gradual development of the situation which has brought us a different class of refugee has also brought about a very important modification of opinion with regard to the conditions of their reception. It has been decided

that the employment of refugees instead of being deprecated should now be encouraged, and that instead of depending for subsistence on the hospitality of the country they should as far as possible be enabled to support themselves. A Government Committee has been appointed, as you know, under the chairmanship of Sir Ernest Hatch, to consider the conditions under which effect can be given to this new view of the situation. Belgian Labour Bureaus working in connection with the Central Labour Bureau have been established in the Government refuges, as also in the Rink at Aldwych. Recruiting bureaus have been established in the Government refuges, by means of which Belgians of military age are enabled to join their colours and return to the front at Flanders. By these agencies, in conjunction with the Government refuges and other forms of Government relief for urgent cases, the problem of the reception of working-class refugees may, I think, be said to have been met and disposed of.

The problem with which, since Christmas, we have been most acutely preoccupied is the problem of giving suitable help to the urgent needs of the propertied and professional classes. This is a class with which I have myself been thrown into close and constant touch, and the sorrows and difficulties of their position are very vivid to me. They have suffered, of course, horribly in regard to their material possessions, and the numbers increase daily of persons accustomed to live in the comfort of comparative affluence who are reduced to absolute penury. Such cases call for the sincerest sympathy and for practical help. Where only material possessions are concerned they do not, it must be recognised, make quite the same poignant appeal to elemental emotions that was made by the earlier refugees. But there is seldom a day in which some special case does not present itself. A day or two ago it was a case of a man of good position and once ample means, who had seen his wife and daughter shot by the Germans, and who came in search of some educational facilities for his little boy, the only member of the family now left to him. He was entirely penniless. The next day it was a manufacturer from Louvain who had shared in all the horrors attending the destruction of that town. His town house and his country house, with all that they contained, had been destroyed. He himself had been taken as a hostage by the Germans. He was three times blindfolded and ordered to be shot, and three times at the last moment the order was countermanded. He was beaten and spat upon. He was forced to march with other Belgians as a covering rank in front of the German advance. As he said, in very quietly relating these experiences: "It is doubted whether the Germans really used Belgian civilians as a covering-shield for their soldiers. I *know*, because they have used me. They put us in the front of their attack and bullets whistled between us as we advanced." But these things were all as nothing to the anguish of knowing that the soldiery which had marched him away in one direction had taken his wife away in another. It was impossible for him to know anything of her fate. After some days of marching in front of the German troops they came in touch with Belgian outposts. He was able to effect his escape, and he reached Antwerp through the Belgian lines. Still unable to obtain any news of his wife, he advertised in the hope that the news he gave of himself might reach her eyes. It did. After long delay the news was brought to him that she was alive, that she had escaped without serious injury from the Germans, and that she was in hiding in the neighbourhood of Louvain. To reach her he went on foot from Antwerp to Louvain, passing as he could through the German lines, hiding at times in ditches and swamps, wading through rivers to avoid the guarded roads. He told me the whole story with absolute calm, and only when he came to the climax of their meeting he suddenly broke down. "My wife," he said; "she had been living in the woods and fields with practically nothing to eat. She was a black skeleton, mere skin drawn over her bones." He could say no more. I didn't wish that he should. My business was merely to find him some means of living now that he and his wife were together in a place of safety. You can understand that, after hearing such a story, one's only feeling is that peace and security must somehow be assured.

In the early part of the movement such cases as these were provided for by private hospitality, and I come now to the greatest change of all which the movement has undergone. The movement of private hospitality, which has provided from first to last for a figure approaching to something like a quarter of a million refugees, has, as was to a certain extent inevitable, exhausted its first impulse. About Christmas-time we began to realise that the offers of hospitality had ceased. No fresh offers came, and hosts who had previously had Belgians in their houses wrote that they would shortly be needing this accommodation for other purposes. Our Allocation Department became a

department of reallocation. Gifts of clothing also sensibly diminished.

The funds of the War Refugees' Committee, which have been devoted to the relief of Belgians in England, have never been very great. Public contributions in money have been more usually given to the Belgian Relief Fund, which is entirely devoted to the relief of Belgians in Belgium. We have sometimes thought that the public did not clearly understand the distinction between the two Funds. Our wealth has consisted mainly in offers of hospitality and gifts in kind. When these began to cease we saw ourselves in danger of being unable to continue our work for want of means, and this situation introduced the present and latest chapter upon which we have entered.

I am sorry that I am not able at present to enter into a full explanation of schemes which are as yet imperfectly developed. A time will come when all information will be freely given. For our present purposes I will ask you only to take from me that we have been able to obtain, under certain conditions, a command of funds which permit us to give relief in cases of strict necessity. The money so available is not to be regarded as a substitute for, but as a supplement to, private generosity. It is, in certain cases, sufficient for the necessities of a working-man. The part of private generosity for better-class refugees still remains to bring the bare necessities of life up to the standard which the nation would wish to offer in such cases as those I have just now cited.

There are many obvious ways in which this can be done. Among them the most generally successful, so far, has been the organisation of large houses on the basis of gratuitous hotels. I have myself organised two or three such houses, notably one at Harrington House, in Kensington Palace Gardens, lent to me for the purpose by Lord Harrington; another at Hambro House in Princes Gate, lent by Mr. and Mrs. Eric Hambro; and a third in the King's Weigh House Parsonage, furnished and lent by the congregation of the King's Weigh House Chapel in Duke Street. In these three houses I have been able to receive about 120 refugees, who make with regard to them very charming expressions of content. What I have done has also been done by many others, and it has been thought that many people who are no longer able to entertain Belgian refugees in their own homes may be willing to contribute towards a system of organised hospitality under which suitable homes can be provided.

Another way of meeting the necessities of the class of refugees of whom we are now speaking is by paying the rent of furnished flats in which a very small grant is sometimes enough to render domestic life a possibility. Among the propertied and professional classes there are some who have still some small resources. For these the active brain of Mrs. Lyttelton has devised a scheme, which she is administering as a branch of the War Refugees' Committee, of flats furnished by the Committee and placed at the lowest possible prices at the service of the refugees. The scheme deserves a fuller description than I am able to give it. In all schemes of hospitable relief the national food supply, of which the gratuitous food is in great degree contributed as a free gift by our colonies, plays an important part.

I would like to have been able to do justice to other institutions for the assistance of refugees which have from the beginning of the movement developed as branches of the Allocation Department at Aldwych. I can only permit myself just to name the Education Department, under Lady Gladstone, Mr. Englehart (of Leper Island fame) and Father Christie, where, by a movement of educational hospitality offered by the public schools, the Catholic institutions and the universities of the country, free education has been provided for nearly two thousand Belgian young people. In this movement I am glad to be able to say that Eton, Oxford and Cambridge have handsomely done their part.

Another branch of activity which has been of the greatest value throughout the whole movement has been the Health Department, which, under Mrs. George Montagu, assisted by Miss Page, the daughter of the American Ambassador, has given help and relief to hundreds of cases of the sick and otherwise disabled.

All these and many other departments are still active at Aldwych. Lord Lytton, Lord Gladstone and Mr. Dickinson, who have been associated in a Management Committee since the opening of our latest chapter, have their time fully occupied. There is no sign of any diminution of work. Neither is there on our part any diminution of energy or of interest in the work which still remains to be done.

You may be inclined to think from the particulars which I have given you of this latest chapter of the work that the heroic moment of the movement has passed for England as well as for our guests. I would only venture to say that in heroic moments resolutions are conceived —it is for subsequent acts to give them shape.

In the details which I have given you we are simply working out the national resolution that the exiles now in our midst shall be cared for, helped and protected to the limits of our ability in this country, until the day dawns for them when they may return to the homes they love. We see no end, and we desire to see no end, to our exertions but the day of repatriation. Be that day near or far, we continue our work till it is reached, and we look with quiet confidence and absolute assurance to the public we know to give us the full support of its sympathy and its help.

DISCUSSION.

The Chairman (Colonel Sir Thomas H. Holdich, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc.), said the meeting had listened to a very moving address, and he thought he could assure Lady Lugard of every listener's heartfelt sympathy in all she had said. Lady Lugard was owed something more—a meed of admiration for her marvellous initiative which had set such a great organisation on foot. It had been very satisfactory to him to note that throughout the address Lady Lugard had preserved what he might call a due sense of perspective. She had never allowed mere sympathy to degenerate into anything like weak sentiment. There were many points in the address upon which no doubt various opinions might be expressed, but for his own part he would confine himself to one, namely, to the resolution of the Committee as to the employment of Belgians. He considered that a most wise resolution. He was quite sure that the Belgians themselves would prefer it. It was always pleasanter for a people to know that they were doing something useful than that they were merely living on hospitality. He had seen, at Earl's Court for instance, Belgian men who would be fairly capable of undertaking work in assisting to turn out munitions of war; and he knew there were many Belgian women who could teach English women a great deal in household matters, especially in the art of lace-making. He also thought that Lady Lugard had done well to make a brief reference to those terrible scenes which had been enacted at the beginning of the war—"Lest we forget." In England there was always a number of apologists. There were people always ready to apologise for anything. He believed, really, there were people who would apologise for the Devil himself. But no apology, to his mind, could ever cover those terrible iniquities of the first advance of the Germans into Belgium. It was just as well that now and then we should be reminded of them. To himself it was perfectly incomprehensible how the Germans, as we knew them before the war, could ever have lowered themselves to employ such methods, or to approve of them. One could imagine only that they were obsessed by the notion that, like the Children of Israel in old times, they had a Divine mission to perform, and that it was their business to regenerate the world by fire and sword. That seemed to be an ingrained belief in the mind of every German, and it was certainly a very curious physiological factor in the war, which hereafter might be subject to examination and explanation. He could only express a hope that the terrible sufferings of Belgium, and that "consolation of a nation by a nation" to which Lady Lugard had referred, might result in a much better and closer understanding of those brave and patient people; and that ultimately between ourselves and our nearest neighbours on the Continent—Belgium and France—there might arise a community of policy which would in the end tend to secure the peace of Europe.

Monsieur le Comte de Lalaing said, although he was bashful in taking the opportunity to say a word, yet it was too precious to let slip by. He was very happy to be able to congratulate, and to thank most deeply, Lady Lugard for all that she had said and done. What she had done for the Belgians would never be forgotten. She had been a friend of the first hour and a friend in the greatest need, and Belgium's gratitude would always be hers.

Mr. E. H. Rhodes said, as having taken some part in the work of the Committee under the Local Government Board, he was glad to have heard Lady Lugard explain the immensity and variousness of the work of the Committee. He had been speaking to a man from Lancashire the other day who had asked him to whom money from Lancashire could be sent. He told the gentleman to send it to the War Refugees' Committee, and the reply was, "Oh, I always understood they worked in London, and in London alone." That mistake seemed to be rather a general one, which was a great pity, and he suggested to the Committee whether they might not advertise a little more. The public had not realised the immensity of the work of the Committee.

Mr. F. M. Guedalla said, as one of the original members of the executive committee of the War Refugees' Committee, he thought he ought to bear some personal testimony to the inspiration and leadership which that Committee had enjoyed, and under which it had accomplished its work, at the hands of Lady Lugard. Doubtless it had been noted in the address that she had referred to the activity of everybody but herself and of every department other than her own. When he first met Lady Lugard in connection with the work it had been at Aldwych at nine o'clock in the morning. She would leave the office at about seven or eight at night to join those who were engaged in the transport department at the

reception of refugees at the different stations, which would mean very often working till one o'clock in the morning, in addition to which she was helping to organise the different hostels. The public could hardly be aware of the magnificent work which was being done by women. He had been amazed at the organising capacity of women at Aldwych. There were many complaints at first with regard to the work they were doing, but his own experience was that once the different women knew what were their departments, they kept to their departments and managed them admirably. One of the greatest organisers he had ever come across was Lady Emmott. With regard to subscriptions, he believed from first to last the Headquarters' Committee had received about £70,000. He could assure his hearers that they could do with another £100,000 if the public would only give it. It was very necessary not only to get repeated offers of hospitality, but above all it was necessary, almost for the first time in the Committee's existence, to get such subscriptions of money as would enable a woman like Lady Lugard and a man like Lord Gladstone to carry on the work as efficiently in the future as it had been carried on in the past.

On the motion of the CHAIRMAN a vote of thanks was accorded to Lady Lugard for her paper.

THE AGRICULTURAL AND MINERAL RESOURCES OF AFGHANISTAN.

Although a greater part of Afghanistan is more or less mountainous, and a good deal of the country is too dry and rocky for successful cultivation, yet there are many fertile plains and valleys which, with the occasional assistance of irrigation from small rivers or wells, yield very satisfactory crops of fruit, vegetables, and cereals. The fruit industry is, next to that of sheep, the source of greatest wealth to the country. In certain districts fruit, both in its fresh and preserved condition, forms the staple diet of a large part of the population throughout the year. A rapidly growing export trade in fresh and dried fruit exists with India. In dried fruit, especially raisins, which find a good market all over India, and pistachio nuts, melons, and certain kinds of grapes noted for their keeping qualities, there is a large trade through the Khyber Pass, but most of the fresh fruit is exported through Baluchistan, where transport through Kandahar (around which there are especially fine fruit gardens and orchards) and the Baluchistan railway terminus at New Chaman presents less difficulty. The value of the fruit and nuts exported through the Khyber Pass in 1911–1912 amounted to £95,000, and the value of such products exported through Baluchistan during 1912–1913 amounted to £129,000.

Fruit from Kandahar, together with that from Baluchistan itself, is marketed chiefly at New Chaman and at Quetta (the chief city of Baluchistan), and it is sufficiently large in amount to have necessitated a special daily fruit train to be run from Quetta to different cities in India during August, September, and October, 1913. According to the American Consul on special commercial service in India, the most famous Afghanistan fruit includes a sweet melon known as "sarda," which will easily keep in good condition for four or five months small seedless grapes, and dried raisins made from the same, pomegranates, pistachio nuts, and almonds. The sale of almonds except through agents of the Amir is forbidden. Fruit-farming is divided between orchard fruit, with which vegetable farming is usually combined, and those fruits which may be grown in fields on a large scale.

In the one class are apples, pears, almonds, peaches, apricots, plums, cherries, grapes, figs, quinces, pomegranates, and mulberries, in addition to walnuts, pistachio nuts, the edible pine, and rhubarb, which grow wild in the northern and eastern highlands. Vegetable produce, which also holds a high position in the export trade, includes most domestic vegetables; while of the uncultivated vegetable products, the castor-oil plant, the mustard, and sesame grow in great abundance. The fruit fields also produce several varieties of melons, including musk, water, and scented melons, and cucumbers and pumpkins. In the field of cereal production there are two harvests. One, reaped in summer, is the result of an autumn sowing and includes wheat, barley, and certain varieties of peas and beans.

The second harvest is gathered in autumn from a spring sowing, and embraces crops of rice, Indian corn, millet, arzun, and jowari, besides other grains of less importance. In addition to these cereals, crops of madder, tobacco, cotton, opium, hemp, clover, and lucerne are very generally cultivated. Clover and lucerne are produced for fodder, hemp for its intoxicating properties, and madder, tobacco, cotton, and opium for export. In relation to the other crops, wheat is the food of the people, barley and jowari are given to horses, and arzun and Indian corn are grown for culinary purposes. Among a few large landowners and fruit-growers, improved agricultural implements, garden tools, and pumps for irrigation are used, but in most cases the high transport cost makes their purchase prohibitive. The cultivation of turmeric and ginger, and horse-breeding are important. Silk is produced in large quantities at Kandahar, which is also the centre of other arts and crafts. The quality of Kandahar silk is capable of much improvement. The cocoons are small, of unequal size, and of different colours—yellow, white, and grey.

Except a gold-mine near Kandahar, in charge of Europeans, the mineral resources of Afghanistan are almost entirely undeveloped, but in different localities, gold, silver, iron ore, copper ore, lead, lead with antimony, silicate of zinc, sulphur, sal-ammoniac, gypsum, coal, and nitre are known to

exist. Rubies are occasionally found near the Oxus River. Rosaries are extensively manufactured at Kandahar from soft crystallised silicate of magnesia. This is quarried from a hill about thirty miles north-east of the city, where soapstone and antimony are also obtained in considerable quantities. The stone varies in colour from a light yellow to a bluish white, and is generally opaque. The most popular kind is straw-coloured and semi-transparent. A few specimens are of a mottled greenish colour, brown or nearly black; they are used for the same purposes as the lighter varieties. Rosaries and charms of various sorts are made for exportation to Mecca. The waste powder from the rosary industry is used as a remedy for heartburn.

THE CEMENT TRADE IN BRAZIL.

The quantity of cement imported by Brazil has increased very considerably of late years, and in 1913 was six times greater than in 1904.

The following figures, taken from a report of the Italian Legation at Rio de Janeiro to the Foreign Office at Rome, give some idea of the magnitude of this trade at the present time:—

Year.	Quintals.	Imports in English Tons.
1904	940,561	92,575
1910	2,641,706	260,010
1911	2,686,981	264,467
1912	3,670,315	364,251
1913	4,653,143	457,986

The average quantity imported annually during the last three years from different countries is given in order of their importance as follows:—

Country.	Weight in Quintals.	English Tons.	Per-centage.
Germany	1,319,313	129,853	44·00
Great Britain	871,810	85,808	29·06
Belgium	557,336	54,856	18·58
France	82,785	8,148	2·75
United States	72,746	7,160	2·42
Denmark	51,602	5,079	1·72
Austria-Hungary	25,661	2,526	0·82
Italy	466	46	0·04
Other Countries	17,918	1,761	0·61
	2,999,687	295,237	100·00

In this total of 2,999,687 tons Germany contributes nearly half, whilst Great Britain contributes more than one quarter. It is to be hoped that the cement manufacturers of England will take advantage of the present opportunity of extending their trade in Brazil and secure the first place.

The American brands, known as the "Lehig" and the "Atlas," in barrels weighing 150 kilogrammes (about 3 cwt.) gross, are in good demand at the present time in the Brazilian market. The prices average at Rio de Janeiro 2 dollars 10 cents per barrel (about 8*s.* 5*d.*). The cement imported from the United States enjoys a reduction of 20 per cent. off the Customs duty.

QUAY ACCOMMODATION AT PORT OF GENOA.

Notwithstanding the improvements that have been made during the last quarter of a century at the port of Genoa, the need for expansion in the facilities for discharging and embarking cargoes appears still to be making itself felt as much as ever.

In the opinion of some authorities the present congestion at this port is not so much due to the lack of a sufficient number of railway trucks as to the insufficient length of the quays, as compared with the tonnage of the goods handled.

In 1893, according to the report of a commission then appointed to inquire into the conditions of the port and its future, it was stated that the length of the quays and jetties was 6,500 metres (21,320 ft.), and the total tonnage handled (imported and exported) amounted annually to 3½ millions of metric tons, which gives a proportion of 538 tons per metre run (161·5 English tons per foot run) of quay.

This ratio, however, appears to have been too great, and in order to provide for the future development of the port during the period from 1893 to 1913, by the end of which it was estimated the tonnage might reach 6,350,000 tons annually, it was considered that at least 14,300 metres (46,904 ft.) run of quays would become necessary. This would give a ratio of 445 tons per metre (133·5 English tons per foot) between the length of quays and the goods handled, which, in the opinion of the commission, would be a fair proportion in order to ensure the economic working of the port.

During the twenty years which have elapsed since the last report was made, the tonnage handled every year at Genoa has more than doubled, reaching the figure of 7,427,272 tons in 1913, whilst the length of quays has only been increased about 30 per cent., being now 8,500 metres (27,880 ft.), which gives a proportion of 874 tons per metre (262·3 English tons per foot). This obviously must be a drawback to the economic working of the port, notwithstanding the greater facilities afforded by the employment of modern plant for the loading and unloading of ships, the erection of granaries and warehouses, etc.

The ratio is still more noticeable when it is considered that of this 8,500 metres of quay, 7,150 metres (23,482 ft.) are occupied for the landing of 6,215,000 tons, and 1,350 metres (4,428 ft.) for the shipping of 1,212,966 tons of merchandise. This gives a ratio of 869 tons per metre (260·6 English tons per foot) in the first and nearly 900 tons per metre (270 English tons per foot) in the second

INDUSTRIES AND COMMERCE OF RIO GRANDE DO SUL.

Rio Grande do Sul, the most southern of the Brazilian States, extends from lat. 27° S. to lat. 34° S. It enjoys a more temperate climate than that of any other part of the Union. To the north-west, the Uruguay River forms the natural frontier line with the Argentine Republic; the upper reaches of that river separates it from the sister State of Santa Catherina. It is bounded on the south by the South Atlantic Ocean, with a seaboard of about 400 English miles.

The interior of the country, however, is cut off from the sea coast for a distance of about 300 miles by two lagoons, called the laguna dos Patos and the laguna Mirim, which extend in a parallel direction to the shore, from which they are separated by a narrow strip of land. The lagoons are connected by a channel called the Rio Sao Gonçalo. Another channel, termed the Canal de Norte, offers the only means of access to the lagoons from the ocean. The town, which bears the same name as the State, with its little port, is situated on the banks of this channel, close to its junction with the laguna dos Patos, and about ten miles from the sea.

Until quite recently, the channel has been available only for small vessels, on account of the sandbanks by which it was obstructed, leaving a depth of only 4 metres (13 feet) available at low water. In 1906 a concession for the construction and working of a port on modern lines was granted to a French company, who have undertaken to deepen the channel to 10 metres (32 feet 9 inches) by the removal of upwards of 8 millions of cubic metres of sand, and so permit ships of large tonnage to enter the port, lie alongside the new quays which are being constructed, or to continue their voyage to Porto Alegre at the other end of the Patos lagoon, some 170 miles further north from the new port at Rio Grande do Sul.

Two breakwaters or piers, about 1¼ miles in length, are being constructed to form the entrance from the ocean. They are intended also to act as training walls to the current, and create sufficient scour in the channel to keep it free from accumulation of sand. According to the official returns published by the company, it seems that the trade of the port has considerably increased since the works have been commenced. In 1906 the 270,000 tons of goods exported or imported from the port had increased to 415,000 tons in 1910, to 439,000 tons in 1911; whilst the tonnage that crossed the bar for this and other destinations on the two lagoons, which amounted in 1906 to 467,000 tons, had increased to 590,000 tons and 668,000 tons in 1910 and 1911 respectively. About half a kilometre in length of new deep-water quays have been completed, with sidings and connections with the railway. This new port is about 375 miles from Monte Video.

The two principal industries of the State of Rio Grande do Sul are, like those of its neighbour Uruguay, pastoral and agricultural, and its products—jerked beef, hides, tobacco, beans and manioc—are for the greater part required for local consumption. The animal residues—hides, horns, and wool—are mainly exported.

The forests furnish a considerable quantity of timber for building purposes, which is exported principally to the districts on the Plate River. They also furnish many kinds of useful and beautiful woods, adapted for cabinet-making and other purposes.

The mineral resources are of comparatively little importance, although deposits of coal and auriferous quartz are worked on a small scale. Copper, wolfram, and other minerals are found also.

The manufacturing industry in 1911 was carried on in 1,557 establishments, and chiefly consisted of weaving, boot and shoe making, straw and felt hats, breweries, mineral waters, perfumery, and other products for local consumption.

According to the latest available statistics, the total value of the production of the country is estimated to be 82,000,000 milreis * (£5,125,000 sterling), of which 60,000,000 milreis (£3,750,000) is consumed locally, and 22,000,000 milreis (£1,375,000) exported. The chief exports are wool, hides, tallow, lard, horns and other animal residues, manioc, maté, etc. The principal countries to which these were exported previous to the war were Great Britain, Uruguay, Germany, Argentina, and Italy.

The imports are estimated at about half the value of the exports, and were chiefly cotton goods and general merchandise "made in Germany"; wines, oil, straw and other hats from Italy; motor-cars from England, Germany, and Italy.

Previous to the war, the steamers of various German lines of navigation touched at Rio Grande, as well as those belonging to Lloyd Brasiliere, Sociedade de Navigaçao, Anonyma Atlantica, and several French and Portuguese lines of steamers.

CUTCH IN MALAYA.

In consequence of the serious shortage of tanning extracts in English tanneries, the forest authorities of the Federated Malay States and Straits Settlements, says the Malay States Information Agency, have been carrying out investigations with a view to directing the attention of

* The milreis of Brazil = gold, 2*s.* 3*d.* English money, and about 1*s.* 3*d.* in paper currency.

British manufacturers to the possibilities of the development of an export trade in cutch from Malaya.

A reference to the trade statistics of the Straits Settlements shows that in 1913 there were imported into the ports of the Colony 2,163 tons of cutch valued at £30,337. Almost the whole of this valuable commodity came from Brunei, in the Island of Borneo. Of the total, less than a fourth was exported to the United Kingdom. About a half went to Germany, and the United States was the other large consumer, followed, a long way behind, by Denmark and Spain.

There seems to be no reason why the British manufacturers should not take the place hitherto occupied by the German and American users; still less reason for the Malay Peninsula not contributing to the world's requirements in this particular trade. The Conservator of Forests, Federated Malay States and Straits Settlements, has been carrying out the official investigations. He reports that there is an area of about 250 square miles of mangrove forest on the coast of the States of Perak and Selangor. There are nine predominant species of mangrove, and of these six are of value in the production of cutch. The whole forest is now a Government reserve forest, and is systematically worked for firewood only. No attempt has ever been made to work the mangrove bark for cutch. All the bark is at present a waste product, with the exception of a small quantity used locally for dyeing fishing nets and sails. The forests are intersected by innumerable creeks and streams, which render transport easy.

With the Governments of the Straits Settlements and Federated Malay States ready to encourage the growth of new industries, there would thus appear to be an opportunity, arising out of the British manufacturer's necessity, for someone to initiate and foster a trade in cutch from a portion of the Empire which has been coming more and more into public notice in recent years. Shipping facilities from the Straits to this country are regular, and not only could the present requirements of the Mother Country be satisfied, but there is now an excellent opportunity of taking up a comparatively undeveloped industry.

IRON AND STEEL INDUSTRIES IN THE FRENCH DEPARTMENTS OCCUPIED BY GERMAN TROOPS.

The following statistics, published in a German paper, appeared in the report of a conference of the Association of Steel Makers in Germany, lately held at Düsseldorf. They give some information respecting the present state of the iron and steel making industry in the North of France, in the departments now occupied by the Germans. According to the figures given, the percentage of the territory in the ten departments now in the hands of the Teutons is:—

The whole of the department of the Ardennes, or 100 per cent. of its area; Nord, 70 per cent.; Aisne, 55 per cent.; Meuse, 30 per cent.; Pas de Calais, 25 per cent.; Meurthe-et-Moselle, 25 per cent.; Somme, 16 per cent.; Marne, 12 per cent.; Oise, 10 per cent.; and the Vosges, 2 per cent. In all about 2 millions of hectares (7,720 square miles), or 3·7 per cent. of French soil, containing 3,255,000 inhabitants, or 8·2 per cent. of the entire population of France.

This comparatively small extent of the country, now under German rule, contains a very large number of the iron and steel works of France, of which the following percentages are in the hands of the enemy, namely: Manufactories of iron pipes 100 per cent., iron mines 90 per cent., iron girders 88·3 per cent., pig iron 85·7 per cent, coke 78·3 per cent., cast steel 76·9 per cent., steel rails 76·6 per cent., steel ingots 76 per cent., puddled steel 62·4 per cent., iron plates 63·2 per cent., iron wire 52·2 per cent.

It is also stated that the present annual output of steel "made in Germany" amounts to 10,800,000 tons—that is to say, 3,000,000 tons more than is produced annually in the United Kingdom.

THE DEVELOPMENT OF THE TEXTILE INDUSTRIES.

Army Clothing.—It does not appear that our military preparations are suffering from want of cloth, although its conversion into uniforms may introduce passing difficulties. A clothier has been shown in London one three-acre floor piled to its utmost capacity with cloth, eight warehouses each 480 yards long similarly filled, and a one-acre room full of linings and trimmings. All this is additional to the great stocks in the stores in Manchester and Leeds, and to the extraordinary quantities in the hands of the clothing contractors. New supplies are being made pell-mell, and further contracts have lately been placed. Perhaps on these accounts there is no word of the commandeering of textile factories, as there is of engineering shops. Several groups of workpeople in the woollen and worsted trades have been placated by advances of wages or exceptional payments for overtime, and there has been no suggestion of "Ca' canny." The great run upon wool for military purposes has, of course, not been without its inconveniences to civil trade. Apart from the delays to goods on order, new civil business has been discouraged by the much enhanced cost of raw material, and by the premium put upon yarn by the unprecedented demands made on worsted spinners' facilities. Crossbred wool, such as is used for the uniforms of the rank and file, was not cheap at the outbreak of war, and is now appreciably more than 50 per cent. dearer. Merino wool, used for officers' uniforms, for much hosiery, and for soft dressgoods and cloths in general, is now as dear as when there was a famine in the article, despite that so much Continental

consumption has been cut off. Wool traders have a handy way of comparing the value of the one sort with the other, by calculating that one pound of merino buys so much crossbred. In extraordinary circumstances, one of merino tops has been known to buy virtually three of crossbred. Normally, 60's merino buys about two of 40's crossbred, and currently it buys about 1½; so deranged is the usual scale of comparative values.

The Use of Designs.—It is probably the general opinion among artists that manufacturers know nothing of art, and manufacturers are at no pains to disguise their belief that professed artists know nothing valuable about manufacturers' requirements. The estrangement between the pair robs discussions of art and industry of some vitality they might possess, were it possible to come closely to some common point. By way of clearing the air a little, Mr. W. T. Hesketh, head of the designs' department of the great Calico Printers' Association, gave a Manchester audience one fact about machine production. In particular he mentioned that from 40,000 to 50,000 new designs passed through his own hands in a year, all of them involving some exercise of the artistic faculties. These opportunities for the employment of artist-designers were put in contrast with those of the past, when printers' blocks were handed down from generation to generation. The number is manifestly large enough to include designs that are defensible upon the ground of taste, doubtless along with others that can best be condoned by the plea that somebody in the world wants them. In the eye of the manufacturer, the merit in any design resides in the orders that can be got for the goods. The multiplicity of designs is an uneconomical evil; the ideal would be to run the whole factory upon a single design and obtain a working profit by doing so. The ideal being unattainable it is requisite to provide such a profusion as will ensure steady and profitable work. Designs are selected with that view rather than for their gratuitous merits, and it is apparent, from experience everywhere, that the more austere their character the more limited their appeal; the shorter the yardage to a pattern, the more must be charged to cover the cost of manufacture. Such is human nature that long prices cannot be got for articles produced in more than very limited number. These are the conflicting circumstances within which the practical manufacturer works. Enlightened public demand might lift the artistic level of common goods, or—in company with economic changes—promote the production of what in effect are limited editions. Necessarily, the manufacturer with machines waiting has to deal with conditions as he finds them.

Co-operative Dyestuffs.—The old misunderstanding between artists and manufacturers has points of resemblance to the recently acute difference between scientists of high distinction and the textile manufacturers chargeable with the direction of the Government dye scheme. Chemists cannot be reproached for looking upon the occasion as one for the exercise of scientific virtuosity, or for regarding British Dyes, Ltd., entirely as a chemical industrial concern. The textile consumer of dyes sees in it a co-operative supply company, a means which is apparently the only—if not the best—one of obtaining colours that he indispensably wants. The consumer knows, in an unscientific way, what he at present wants rather better than any man of science can tell him, and the production of dyestuffs to meet the emergency is the first measure indicated. Perhaps it is not entirely by chance that, in the persons of Mr. Kenneth Lee and Mr. G. Garnett, the company has secured two directors who have paid quite an exceptional amount of attention to the use of fast dyes. The points are mentioned without prejudice to any valid claim that colour chemists may have had to fuller recognition. The English and the German prophecies of disaster awaiting this concern do not make its subsequent development any less interesting to follow. The difficulties of an uncharted voyage are naturally great, but it is worth remembering that there are certain points to steer by. The kinds, quantities, and prices of the colours first wanted are definitely known.

Foreign Debts.—Advances upon the security of outstanding foreign debts are still being received under the Treasury scheme by textile exporters and being paid over to their suppliers. It appears that the banks in some cases object to place other creditors in a better position than themselves, with the result that some such instalment as 50 per cent. is left owing. Exporters with large debts due from Germany and Austria are not sanguine about an early liquidation after the conclusion of peace. Some expect fully two years to pass before a settlement is effected of all the difficulties that may be raised. For six months the position of those yarn and other merchants whose business lay wholly in the hostile countries has been one of extreme anxiety. It is satisfactory to learn that some of them, by a quick adaptation to changed circumstances, are now doing nearly as much business at home and in neutral markets as ever they did in the countries that are closed to them.

Zeppelin Cloth.—A Manchester prosecution has elicited the fact that a cloth made in Chorley has been used hitherto for the ballonets of the Zeppelin airships. The fabric is a longcloth

or cambric exceptionally strong for its weight, and not signally different from such as may be used for embroidering upon, or conversion into, tracing cloth, or even into typewriter ribbons. Apparently the same cloth has been employed by airship constructors in this country. The manufacture of tracing cloth is quite an old British trade, and certainly of seventy years' standing. Typewriter ribbons may actually be prepared in this country, although a few years back they were not. The particularly fine and regular fabrics used for the ribbons were woven in Lancashire, slit up and impregnated with colouring matter abroad, and reimported in the finished state. It would seem that a good deal more of the similar cloth used for embroidery goes to St. Gall than to Nottingham, where there are, however, Schiffli machines.

Cloths and Skirts.—The lively discussion over the propriety of marked changes made in fashion amounts to a capital advertisement for those who are interested in the alteration of feminine silhouettes. Wider skirts, being garments requiring more cloth than narrower ones, might seem to be eminently to the interest of textile manufacturers as well. Actually the case is more complex than it may look. Notoriously, the coming of the hobble skirt was bad for particular classes of the weaving trade. The yardage required was reduced as a whole, dress fabrics of certain sorts were disqualified absolutely, undergarments of more than one kind were abolished, and all sorts of consequential damages were inflicted on the business in trimmings. The revolution involved some suffering, and the extinction of a certain number of private concerns; but there were some compensations. What was taken out of the length was put back more or less in the weight of the fabric used to make the skirt. New kinds of undergarments were introduced in place of the banished articles, and a general accommodation to circumstances was effected. The reversion to wider skirts involves the more or less gradual undoing of the whole process. For the present, the fuller garment does not require the substitution of cloth much lighter in weight than that taken recently; but once a beginning is made extremes are reached pretty quickly. The makers of the lighter cloths being different persons from the manufacturers of the heavier ones, the gain of the one is the loss of the other. It is not easy to arrive at a just balance, but so far as the present is concerned, it is reasonably apparent that the needs of manufacturers making coating, or the heavier cloths, are greater than those making light stuffs. What can be said is that the change involves a disturbance, and that it would be against all precedent were the needs or claims of manufacturers to have any influence at all in directing the course that such changes shall take. Equally with the protesting buyers and wearers of the skirt of the moment, the producers of cloths are the victims of independent powers.

CORRESPONDENCE.

PATENT LAW REFORM.

I hope I may be permitted to correct a slight inaccuracy in the report of Mr. J. W. Gordon's highly interesting paper on "Patent Law Reform," which was read at the meeting of the Society on Wednesday, March 10th.

In his references to the subject of technical education, Mr. Gordon speaks of the late Sir Bernhard Samuelson as Chairman of the Devonshire Commission. The Commission to which allusion is made was a Royal Commission appointed in 1881 by Mr. Mundella, when Mr. Gladstone was Prime Minister, and had no connection with the Duke of Devonshire.

Later on, in the year 1896 (not 1897), three members of that Commission, of whom I was one, together with their secretary, visited Germany—at their own initiative and at their own expense—in order to ascertain for themselves what progress had been made since 1884, the date of the publication of the Commissioners' report. On their return they drafted a report as to what they had seen, giving the conclusions at which they had arrived, and it was suggested that this report might be made in the form of a letter addressed to the late Duke of Devonshire, who was then President of the Council in Lord Salisbury's Government. This was done, and the letter, referred to by Mr. Gordon "as the second report of the Commission," was ordered to be printed and presented to both Houses of Parliament.

It is true, as stated, that the letter when published "gave rise to an important newspaper discussion upon the whole subject of technical education."

PHILIP MAGNUS.

Athenæum Club, March 14th.

NOTES ON BOOKS.

HISTORY OF THE STANDARD BANK OF SOUTH AFRICA, LTD. By George Thomas Amphlett. Glasgow. Printed at the University Press by Robert Maclehose & Co., Ltd.

The Standard Bank of British South Africa, Ltd., was established in 1862. At that period Cape Colony was a very different thing from the modern Union of South Africa. Steamship communication with England occupied over forty days, the cable was not dreamt of, and responsible government but vaguely mooted. Postage to England by the mail packets was 1*s*. per letter, and within the Cape it was 4*d*. per half-ounce.

The first railway from Cape Town to Wellington was under construction by a private company. The Colony had a territory of some 300,000 square miles, with a white population of about 300,000. The export trade of Cape Colony and Natal was little over £2,000,000, as compared with some £65,000,000 at the present time. The diamond fields and gold-mines had not yet been discovered; the ostrich-feather and mohair industries hardly existed, while the shipments of wool were little more than £1,225,000.

It may be said, then, that the history of the Standard Bank has been contemporaneous with the great and ever-increasing development of South Africa, for which, no doubt, it has been largely responsible. The beginnings were, naturally, on a comparatively small scale: the capital was, in the first instance, fixed at £1,000,000, in 10,000 shares of £100 each, with power to increase to £2,000,000. There was no difficulty in raising the amount asked for, and before the time for closing the share list had arrived applications had been made for 43,000 shares.

From its inception to the present the history of the bank has been a story of continuous development. It has, of course, had to face periods of depression, and during the South African War there was constant anxiety. For instance, on the outbreak of hostilities the greater number of the bank's staff at its eleven Transvaal branches were expelled from the country and sent away in cattle trucks, not even being permitted to take their personal luggage; and during the siege of Mafeking the bank's business had to be conducted underground in bomb-proof offices. At some of the branches the whole staff were in the trenches, and a considerable number found a place on the Roll of Honour.

The bank is now the owner of many fine buildings in various parts of South Africa, but some of the illustrations record the very humble origins from which they started. The original premises at Buluwayo were a small bell tent, in the dark interior of which are dimly visible a safe and desk. The staff consists of a bearded pioneer in unconventional costume, while the whole is guarded by an armed sentry. A pen-and-ink sketch shows a party of bank officers going off to open a Karoo branch: they are sitting in a couple of light Cape carts, and driving through the rain with a minimum of luggage.

This history is the work of the late Mr. George Thomas Amphlett, who entered the service of the Standard Bank in 1881, and retired from the post of assistant general manager last year. He only lived to enjoy his pension for a few months, but he has left behind an interesting record of a great banking institution.

Motion of Liquids. By Lieut.-Colonel R. de Villamil, R.E. (retired). 86 illustrations, 30 tables, 205 pp. London: E. & F. N. Spon, Ltd.

The author of this book has evidently read widely in the literature of this subject, and has attempted, in upwards of 200 pages, to give an account of his investigations, and "adds his own meditations." The work is dedicated to the two remarkable French military engineers, Dubuat and Duchemin, and this is significant, as a very large proportion of the volume is devoted to descriptions of the experiments of these pioneers. It may be said at once that in our opinion this is by far the most valuable part of the book, and students will be indebted to the author for bringing together in this volume an account of these experiments. After an introductory chapter, two chapters are devoted to a description and some discussion of the experiments of Duchemin, on the way a stream flows over immersed plates, inclined at varying angles to the direction of flow of the stream; diagrams are drawn showing how the stream lines distribute themselves, according to Duchemin, over the plates, and formulæ are quoted for the position on the plates of the "divide" or line dividing the stream lines moving in different directions. Dubuat's and Duchemin's Pitot tube experiments are also described. The next chapter describes similar experiments carried out before Duchemin's time. This is followed by two chapters on Relative Motion and Dubuat's Paradox, in which an attempt is made to show that when a body is at rest in a flowing stream the pressures behind the body are not the same as when the same body is moving at the same velocity in a liquid at rest. The author speaks of the head $\frac{v^2}{2g}$ being the theoretical head which a stream impinging on a body with a hole in it—a Pitot tube, for example—will support, and then shows that cases occur when the head supported is greater than $\frac{v^2}{2g}$. It is doubtful whether the author's method of treatment is sound. If the whole of the momentum of the stream lines approaching the hole were destroyed the head should be As a matter of fact, in the Pitot tube it is $\frac{v^2}{2g}$, and in other cases probably may be between $\frac{v^2}{2g}$ and $\frac{v^2}{g}$, but surely it only means in one case that the stream lines have more of their momentum in a given direction destroyed than in another, and there seems no reason whatever to continue to speak of the so-called Paradox, or to separate what the author calls "impact with shock" from "static liquid." The experiments and the results are, however, of interest. Chapters VIII. and IX. deal with water flowing in jets and the pressure on planes due to the impact of jets. Experiments are described and formulæ quoted. The treatment is not by any means complete. Chapter XII. deals briefly with the flow through mouthpieces, and the following chapter with the flow in rivers and canals. It is claimed that "Resistance in such channels is not caused by the liquid rubbing against their beds; it is almost entirely caused by the liquid changing shape and so forming eddies." This, of course, was the contention of Dubuat, Prony, and many other of the early

workers, who thus urged that the resistance was independent of the roughness of the surface of the channel, and that the slope of any channel could be expressed by a formula $i = Av + Bv^2$, A and B being constants. Following Newton, Dubuat, and others, the author contends that fluid resistance, when the fluid wets the surface, can always be divided into two parts - (1) due to viscosity, and (2) due to density—and that the resistance to bodies moving through water, or water moving over surfaces, can always be expressed by the form $R = Av + B v^2$. He scorns the attempt to express fluid resistances by logarithmic formulæ of the form $R = Av^n$ which, as he says, have been in favour. The accumulated evidence of the last fifty years shows, however, that the resistances of channels and boards moving through water are not independent of the nature of the surface, and though, as Loos has shown from an investigation of the experiments of a number of writers that for smooth pipes a general formula of the form $R = C\left(\frac{v}{d}\right)^n + B v^2$ expresses the fluid resistance of air, water and oil, the coefficients C and B only varying with temperature and density, with a very great degree of accuracy, the index n is certainly not unity.

Space forbids further discussion of the work. As already suggested, it is interesting as giving descriptions of experiments of the old workers, but as its conclusions are based upon a neglect of the enormous mass of data gathered during recent years, they must be accepted with considerable reservation.

F. C. Lea.

GENERAL NOTES.

The Imperial Institute.—In a General Note published under this heading in the *Journal* of March 5th (p. 350), it was stated, on the authority of the annual report on the work of the Institute for 1913, that it was hoped that a Technical Information Bureau would be established shortly. As a matter of fact, this Bureau was established in October last, and has therefore been at work already for five months. It is a special branch of the Scientific and Technical Research Department, and is staffed mainly by experts who have had the advantage of experience in the work of that department, which is carried on in communication with producers in the Colonies and with manufacturers and users of raw materials in this country. The present is a specially opportune moment for the formation of such a Bureau, since the paralysis of German and Austrian trade and industry opens up opportunities for the development of many industries in this country, and in the Colonies, which have hitherto been monopolised by Germany. Apart from its general activity, the Bureau is already playing a part in this work. Special circulars drawing attention to Colonial and Indian raw products of technical interest to British manufacturers will be issued as required, and distributed to all manufacturers likely to be interested. A number of these circulars are already available, dealing with such subjects as "New Markets for British, Colonial, and Indian Copra," "Wattle or Mimosa Bark for Tanning," and "The Production and Uses of Molybdenite." The circulars are carefully prepared from reliable sources, and contain a great deal of valuable information on the subjects with which they deal.

Shipbuilding in Italy.—The *Rivista Marittima* states that fifty new steamers have been added to the Italian mercantile marine during 1914. Of these eight were launched from Italian shipbuilding yards, and the other forty-two were either purchased or built abroad. Of the eight built in Italy, the largest, the "Lampo," of 6,296 gross tonnage, a tank steamer, was built for the Società Italo-Americana per il Petrolio, of Genoa. Three other steamers, of 5,604, 5,459, and 5,366 tons respectively, for the Società di Navigazione Italiana; two others, of 5,503 and 5,479 gross tons, for a private firm of shipowners; and two smaller vessels, the "Aosta," 562 tons, and "Zeta," of 104 tons, for the Società Commerciale di Navigazione Italiana, which are fitted with internal-combustion engines, were completed last year. On January 1st, 1914, nineteen steamships with an aggregate tonnage of 77,637, were on the stocks in Italy, and probably will be launched in the course of the present year.

Rubber Cultivation in British Guiana.—The area under Para rubber cultivation in British Guiana during the 1913-14 season was 4,018 acres—an increase of 879 acres over the preceding crop year. British Guiana lies within what may be termed the "rubber zone," and is adjacent to the home of the Para (Hevea) rubber tree. The plant is cultivated chiefly on the coast. The labour employed on the rubber estates is both negro and free East Indian. The major portion of the cultivated area has been opened up from the original forest and planted with Hevea alone, or with a mixture of Hevea and other crops, but some Hevea has been planted on previously existing plantations. Where rubber has been planted on land previously cleared for other crops, the cost of bringing it to maturity is low. Areas formerly devoted wholly to cacao, coffee, fruit trees, and sugar cane are being utilised for rubber, the existing crops being employed to cover some of the cost of bringing the rubber to maturity. Planting is mostly done by means of basket plants, but where seeds can be obtained in quantity for germination in a nursery on the property, this method is preferable. Various distances have been employed in planting, but the one now in common use is 20 by 20 ft., and is generally considered to give the best results.

SAMUEL MORSE AND THE SOCIETY OF ARTS.—The great reputation acquired by Morse for his telegraphic inventions has caused the fact to be overlooked that he was, at all events in his earlier years, much better known as an artist than as a man of science. The recent publication in America of his "Letters and Journals," edited by his son, Mr. E. L. Morse, records the fact that in 1811 he came to London with an American painter of note, Washington Allston, and that he was awarded a gold medal by the Society for a model of the "Dying Hercules." This award was made in 1813 for "an original cast of Dying Hercules." It was the lesser gold medal. Up to now the fact has never been noticed that the recipient of the award was the great American inventor. It was not until about 1832 that Morse turned his attention to the study of electricity, and not until after 1844 that telegraphs were working under his patents. He died in 1872.

BRYAN DONKIN FUND.—Applications for grants in aid of original research in mechanical engineering should be sent to the Council of the Institution of Mechanical Engineers before October 11th, 1915. The third award will be made in February, 1916, and the amount available will be about £34.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock: –

APRIL 14.—T. THORNE BAKER, "The Industrial Uses of Radium."

APRIL 21.—MORETON FREWEN, "The State and the Fisherman."

APRIL 28.—A. S. E. ACKERMANN, B.Sc., Assoc. M.Inst.C.E., "The Utilisation of Solar Energy."

MAY 5.—AUGUSTUS VERNON HARCOURT, D.C.L., LL.D., D.Sc., F.R.S., "On the Measurement of the Efficiency of Domestic Fires, and on a Simple and Smokeless Grate."

INDIAN SECTION.

Thursday afternoons:—

APRIL 15, at 5 p.m.—PERCEVAL LANDON, "Basra and the Shatt-ul-Arab." The RIGHT HON. EARL CURZON OF KEDLESTON, G.C.S.I., G.C.I.E., will preside.

MAY 13, at 4.30 p.m.—SIR CHARLES H. ARMSTRONG, late Chairman, Bombay Chamber of Commerce, "Indian Trade and the War."

COLONIAL SECTION.

Tuesday afternoon, at 4.30 o'clock:—

MAY 4.—S. CHAS. PHILLIPS, M.S.C.I., "The Empire's Resources in Paper-making Materials." The HON. SIR GEORGE H. PERLEY, K.C.M.G., Acting High Commissioner for Canada, will preside.

Dates to be hereafter announced:—

C. H. SHERRILL, "Ancient Stained Glass."

CHARLES R. DARLING, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

M. H. BAILLIE SCOTT, "House Building: Past and Present." Three Lectures.

Syllabus.

LECTURE III.—MARCH 29.—*Houses of the Present.* The average house of the craftsman period adorned the world—The average modern house disfigures the world—Normal modern building a disease rather than an art—The causes and cure of this disease—Difficulties of the architect—Building by-laws—The qualities of various types of houses discussed—An ideal house described.

DAVID SOMMERVILLE, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 29...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. M. H. Baillie Scott, "House Building: Past and Present." (Lecture III.)

British Architects, Royal Institute of, 9, Conduit-street, W., 8 p.m. Mr. W. A. Pite, "King's College Hospital."

Actuaries, Institute of, Staple Inn Hall, Holborn, W.C., 5 p.m. Mr. R. Todhunter, "Two Notes on Questions of Office-Practice."

TUESDAY, MARCH 30...Cold Storage and Ice Association, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m.

Medicine, Royal Society of, 1, Wimpole-street, W., 5 p.m. Sir Almroth Wright, "The Septic Infection of Wounds."

Photographic Society, 35, Russell-square, W.C., 8 p.m. Mr. G. Avenell, "The Home and Haunts of William Cowper."

WEDNESDAY, MARCH 31...Public Analysts, Society of, at the Chemical Society, Burlington House, W., 8 p.m. 1. Mr. G. C. Jones, "Estimation of Methyl Alcohol in presence of Ethyl Alcohol." 2. Mr. A. G. Levy, "Note on the determination of Niobium in presence of Tantalum, and some reactions of Tantalum Compounds." 3. Mr. T. Macara, "Estimation of Carbon Dioxide in Self-raising Flours and Baking Powder." 4. Dr. W. Versfeld, "Bromine Method of determining Phenol." 5. Miss E. C. V. Cornish and Mr. J. Golding, "A Method for the determination of Chlorine in Cheese."

Royal Archæological Institute, at the Society of Antiquaries, Burlington House, W., 4.30 p.m.

Electrical Engineers, Institution of, Victoria-embankment, W.C., 7.45 p.m. (Students' Section.) Mr. E. T. Driver, "Some Notes on High Tension Overhead Transmission Lines."

Correction.—For the name "Mr. Campbell M. Hunt," in the report of the discussion on p. 421, column 1, of the *Journal* of the 19th inst., read "Mr. Campbell M. Hunter."

Journal of the Royal Society of Arts.

No. 3,254. VOL. LXIII.

FRIDAY, APRIL 2, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

LECTURE BY M. PAUL LAMBOTTE.

M. Paul Lambotte, Directeur des Beaux-Arts au Ministère des Sciences et des Arts de Belgique, has offered to give a second lecture on "Constantin Meunier et les Sculpteurs Belges de son Temps," as a supplement to the Aldred Lecture which he delivered on "L'évolution de l'école Belge de Peinture (1830-1900)" on March 11th.

The lecture, which will be copiously illustrated with lantern-slides, will be given on Thursday, May 6th, at 4.30 p.m.

CANTOR LECTURES.

On Monday evening, March 29th, Mr. M. H. Baillie Scott delivered the third and final lecture of his course on "House Building: Past and Present."

On the motion of the Chairman, Mr. John Slater, F.R.I.B.A., a vote of thanks was accorded to Mr. Baillie Scott for his interesting course.

The lectures will be published in the *Journal* during the summer recess.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

A meeting of the Indian Section was held on Thursday, March 18th, 1915; The Right Hon. Viscount Bryce, O.M., D.C.L., LL.D., F.R.S., in the chair.

The Chairman, in introducing the author of the paper, said that he was a distinguished officer, who had had much experience, not only in the direct work of soldiering but as an explorer. When he (Lord Bryce) had the honour of being Under-Secretary of State at the Foreign Office, nearly thirty years ago, Colonel Yate was wandering about in the least explored parts of the wild region that lay between Mesopotamia and Persia on the one side, and our Indian dominions on the other. He was then making explorations, which proved to be of great value, among the wild tribes of that country, and learning facts on his own initiative, which he was afterwards able to communicate to the proper quarter; and he (Lord Bryce) learnt even then what an adventurous spirit the author possessed, and how capable he was as an explorer. He, however, was not going to deal with those experiences: but he proposed to give some impression of the history and work of the Indian Army, and to pay a very deserved tribute to the gallantry which it had shown at many periods in its career, and which it was showing at the present time quite as brilliantly as ever upon the battlefields of Northern France.

The paper read was—

THE INDIAN ARMY.

By Lieut.-Colonel A. C. Yate, I.A. (Retired).

The Great War of 1914 has been a surprise or rather, an appalling shock, to civilisation. Austria's very ultimatum to Servia was an outrage on justice and on diplomatic precedent. When that ultimatum was delivered, Austria and Germany meant either the subjection of Servia, as a further stepping-stone towards Constantinople, or war. What they got was "War," and war it has been with a vengeance. Journalism revels in the head-word "Hun," and crams "Kultur" down the Teutonic throat. Cathedrals, universities, priceless libraries and art treasures, homes and human life—nothing has been sacred to Germany. The crews of defenceless merchantmen and lives in peaceful dwelling-places have met with no mercy. Hatred of the most venomous type animates all German action towards England. Happily, thanks to the cherub aloft who keeps watch and ward over civilian-run War Offices, and in the hour of danger commits them to

soldiers, our Navy and Army have held their own.* So far, we have given fully as good as we have got, and better. Now look back forty-five years. Our War Ministry then knelt down and worshipped Prussian military organisation. Our Army adopted a territorial system, and our cornets and ensigns became second or sub-lieutenants.† In this case we may well ask, "What is in a name?" Change of title leaves the British officer, the British soldier, and the British regiment what they were before. This war has proved it to the hilt, and never more nobly and gallantly, as the battlefields and trenches of Northern France, and, to the honour of our noble Navy, the icy waters of the North Sea and Falkland Islands know. Yet, almost up to the very day of the declaration of war, the farce of a prospective Anglo-German *rapprochement* was being rehearsed, and even our own infantry, when they faced the Germans on the battlefield, did so in the "double company" formation adopted from our enemies.

Just ten years have elapsed since Lord Kitchener first tried the double company in the Indian Army.‡ 1904 little thought that 1914 would see thousands of Indian troops thus reorganised operating under him, as War Minister, in Europe, Egypt, East Africa, Tsingtau and Turkish Arabia, while the Territorial Army of Great Britain garrisoned the East Indies and Egypt and fought all the world over.

For the brief space of about forty-five minutes I am to have the privilege of giving you my idea of the mould in which the Indian Army has been so shaped that it has become, as it is to-day, a World-power. My essay, to succeed, must fit into a nutshell. I once saw a Limerick kid glove—it should have been a Tipperary glove, but then, you know, it is *not* "a long, long way" from Limerick to Tipperary—I once saw a Limerick kid glove so fine that it fitted neatly into the half of a walnut-shell! I have tried to persuade my paper to model itself upon that kid glove.

The Charter of the East India Company was granted by Queen Elizabeth on December 31st, 1600. That Company had to face at once Dutch and Portuguese rivalry, and from 1660 onward French in addition. The merciless massacre in 1623 of the English at Amboyna—a Dutch settlement in the Molucca group—indicates the intensity of that rivalry. We know what were the methods of Drake, Hawkins, and Raleigh with our Spanish rivals in the Atlantic in the last half of the sixteenth century. Queen Elizabeth's charter enjoined on the East India Company that their trade should not interfere with the rights of any Christian Prince friendly to the British Crown who might already be in possession of territories in the East Indies. We have very early proof that the Company could not possibly, in its relations to and dealings with Europeans and Orientals, dispense with a naval and military protective force. Commander C. R. Low, writing to the *Times* about a year ago, tells us that the Indian Navy was raised in 1613, and for 250 (till 1863) years defended the Company's factories against Dutch, Portuguese, and Mahrattas, policed the waters of the Persian Gulf, and took part in wars in China, Burma, Java, Mauritius, Persia, New Zealand, Sind and Aden. On land it served at Mysore, Multan, and in the Mutiny. One of its earliest exploits was the capture in 1622, aided by the Persians on land, of the famous Portuguese emporium and fortress of Hormuz. The ruins of the Portuguese fortifications are still to be seen near Bandar Abbas. Milton pays a tribute to it in the well-known words, "The wealth of Ormuz and of Ind." The riches of Persia, Baghdad, Samarcand and Bokhara, Herat, Balkh and Kabul, found their way thither, and were exchanged for the products of Europe and the Indies.

By treaty in 1632 with the Shah of Persia and the King of Golconda the English company secured the trade between the Persian Gulf and Southern India, and specially the right of importing horses from the Gulf to the Coromandel coast. This is the origin of the Arab horse trade of to-day, which supplies our Indian cavalry with thousands of remounts annually, and so has its effect even on the fortunes of this great war. The resources of the Remount Department of the British Army are taxed to the utmost in providing horses for the mounted branches of the Home service. We may well be thankful that the Indian Army can horse

* The admirable article on "Civilian Control in War" in *Blackwood* for February, 1915, should be read, coupled with the letters of Lord Roberts and Sir Lonsdale Hale in the *Times* of December 2nd and 4th, 1912, on "The Art of Strategy" learnt in German Schools of Law and Philosophy.

† Professor Spenser Wilkinson writes, in the *Westminster Gazette*, March 18th, 1915: "The fate of the country is in the hands of the new second lieutenants. I think they are better men than their German counterparts. That is the basis of my hopes for victory."

‡ General Sir E. G. Barrow, Military Secretary at the India Office, wrote on March 15th, 1915: "The double-company system was experimentally started by me in 1892 in the Hong Kong Regiment, and either in 1898 or 1899 General Sir William Lockhart, then Commander-in-Chief in India, introduced it into the Indian Army." Lord Kitchener finally introduced it.—A. C. Y.

itself, be it with Arab, Australian, or country-bred.

By the beginning of the reign of Charles II. (1660), through whose marriage with an Infanta of Portugal England secured Bombay, the seats of government of the three great Indian Presidencies—Madras, Bengal, and Bombay—were practically settled. We may say that from that date all military and naval operations conducted by or for the East India Company were based on those three headquarter settlements. If I were for one moment to attempt to follow in detail the kaleidoscopic changes which, as history records, passed over the troops on which the safety of those settlements and the advancement and security of their trade depended, I should overstep the limits of my nutshell. We have already spoken of the Indian Navy. When the Home Government saw that some foreign power was seriously threatening our mercantile position in India, it sent out squadrons of the Royal Navy to protect our settlements and interests, and those squadrons generally escorted English troops. Between 1685 and 1780 I find the records of six such squadrons, commanded respectively by Admirals Nicholson, Boscawen, Johnstone, Watson, Pococke, and Hughes. With them came five or ten, or even, as with Boscawen, twelve Independent Companies, each consisting of four or five officers and about 100 rank and file, drawn from the King's troops. These Independent Companies were the English equivalent of the Infanterie de la Marine and the Légion Etrangère of the French. In 1758, when Wolfe and Amherst were driving the French out of Canada, a score or more of these Independent Companies were sent out to the American and West Indian Colonies. The first British battalion, or King's regiment, to land in India came out in 1754 with Admiral Watson, viz., the 39th, or 1st Dorsetshire, which still bears the motto, "Primus in Indis." It was Admiral Boscawen who backed up Stringer Lawrence, "the Father of the Indian Army," as he has been christened, and the first Commander-in-Chief in India. Lawrence reached Fort St. David in January, and Boscawen in August 1748, and then began the struggle with the great Frenchman Dupleix, which was continued by Clive, among several other able soldiers, such as Dalton,* Joseph Smith*; Forde, Eyre Coote, Kilpatrick and Caillaud, and by Admirals Watson and Pococke. The finest French sailor who ever brought a squadron to the East Indies was the Bailli de Suffren, a Knight of St. John of Jerusalem, who came out as the ally of Haidar Ali of Mysore.† Our Admiral, Sir Edward Hughes, was his match, but never scored a decisive victory over him.

During the century which preceded this vital struggle, immortalised in Macaulay's "Clive," grew up the nondescript army, European and native, with which the East India Company protected itself, its trade, its servants, and its possessions. Mr. John Fortescue, in a recent article in the *Times*, states specifically that the three original regiments of European infantry in India the Madras, Bengal, and Bombay Fusiliers (now the 1st Battalion Royal Dublin and the 1st and 2nd Battalions Royal Munster Fusiliers)—had their origin in Independent Companies. Clive did most of his fighting with Bengal and Madras troops, but a Bombay contingent was with him at Chandernagore and Plassey, and in the attack on the Angria pirate stronghold at Gheria; and in 1754, when Dupleix was pressing Madras very heavily, Bombay sent round to them 450 European infantry (100 being Swiss) and 300 Sepoys. The records of the first half of the eighteenth century show that the material of which these Independent Companies in the service of the East India Company was composed was, to use the words of the historians of the period: (1) "The sweepings of the English seaports," "the refuse of the vilest employments in London," and "the off-scourings of prisons and workhouses"; (2) Swiss mercenaries; and (3) Topasses, or half-castes of Portuguese extraction.‡ Companies of artillery, manned by English and Swiss, and troops of Dragoons (English) were also raised. Under Stringer Lawrence, Clive, Dalton, and their successors, the infantry companies were united in battalions for fighting.

* Romney's portrait of Captain John Dalton is in the possession of his great-grandson, Major-General J. C. Dalton, late R.A., and the memoir of him was written by another great-grandson, the late Mr. Charles Dalton, in his day a well-known writer on Army matters.

* Marlborough with his Dutch deputies, Wellington with his Portuguese Regency and Spanish Juntas, and the generals of the French Revolution with their "Representatives of the People," suffered no more than Colonel Joseph Smith with his Madras Council. *Vide* Fortescue's "History of the British Army," Book XI. Chapter VI.

† The Order of St. John of Jerusalem was instituted early in the twelfth century to oppose Islam. Its statutes forbade its Knights taking part in any national or international wars among the States of Christendom. Yet here we have a French Knight aiding a Mussulman against the English. Was it that Order's revenge for Henry VIII.'s suppression of the English Grand Priory in 1540? Or was the act a presage of the ruin that even then overhung the Order?

‡ I even find Caffres, as they called them, *alias* natives of Madagascar, fighting stubbornly at the assault of Nellore in 1757 under the leadership of a British officer.

and about 1760 permanent infantry battalions were formed. When, after the Mutiny, the Crown finally took over the forces of the Honourable East India Company, nine battalions were added to the infantry of the line, and the entire artillery of the three Presidencies was absorbed into the Royal Artillery. To-day the two scientific corps, artillery and engineers, are represented in the Indian Army by three powerful and efficient corps of sappers and miners, and by twelve admirably trained and organised mountain batteries. I find no evidence that European cavalry, even in single troops, were to be found after 1740 in the service of the East India Company, until the time came when His Majesty's regiments of horse were sent out from England.

It has been said that Dupleix taught the English how to conquer India with its own inhabitants. Let it suffice here to say that from about 1745 onwards both English and French commanders took the field with small bodies of European troops supported by some thousands of Sepoys, and occasionally by the ill-disciplined rabble in the service of native princes. Mr. S. C. Hill has just brought out "Yusuf Khan, the First Indian Commandant," which gives us some insight into the formation of the early Indian native regiments. They had English sergeants, it seems, but no English officers till they went on active service. Yusuf Khan, the Subadar of Nellore, was a most able man, and from 1750 to 1762 the trusted ally of Lawrence, Clive, and Dalton. Injudicious treatment then made him revolt, and the Nawab of Arcot, in 1764, was allowed to put him to death.*

Some twenty-six years ago, when the abolition of Presidential armies was already foreshadowed, the Council of the Royal United Service Institution were advised that it would be well, before the last of the old officers of "John Company" had passed away, to have some record of the origin and formation of the three Presidential armies. Major-Generals J. J. H. Gordon, J. Michael, and W. E. Macleod lectured, in March 1888, at the Institution, each on his own Presidency. Vol. XXXII. of the Institution Journal reprints the lectures and the instructive discussions that followed, in which Sir Henry Havelock-Allan, Sir John Watson, Sir William Olpherts, Sir Robert Hume, and Sir Peter Lumsden, among other distinguished officers of the Indian Army, took part. There is a wealth of knowledge there which can only be referred to by me.

Within a few years after these lectures were delivered Presidential armies ceased to exist. Our Indian Army was formed under one Commander-in-Chief, divided at first into four commands—Punjab, Bengal, Madras, and Bombay—and later, as it is to-day, into ten divisions and the Aden Brigade, which are grouped half in the "Northern" and half in the "Southern Army."

It was unquestionably the rivalry of the French that gave an impetus to the improved organisation both of European and native troops in India. As long as the East India Company had only to deal with the princes and people of the country, moderate armaments sufficed. But when such men as Labourdonnais, Dupleix, Lally, and Bussy, supported by French naval forces, came upon the scene, the contest became one of life or death for the Company, and for English prestige in the East. Not only did the English and French leaders realise that every nerve must be strained to create and maintain a fighting force capable of crushing the adversary, but the princes of India themselves saw that, in order to cope with each other and with foreigners, they must have troops trained and organised on the European model. They did, in fact, in the eighteenth and early nineteenth century, what the Japanese began to do after the Meiji. The Nizam of the Deccan, the great Rajput and Mahratta Chiefs, the Peishwa, the Holkars and the Scindiahs, Haidar Ali and Tippoo Sultan of Mysore, and the Sikh Maharaja Ranjit Singh, employed European adventurers of all nationalities to train their armies. The names of Boigne, Reinhardt, Perron, George Thomas, Michel Raymond, Avitabile, Van Cortlandt, Allard, Ventura and Filose, among many others, are well known to students of Indian military history, and to these we may add two names which mark the origin of the 1st, 2nd, and

* Lieut.-Colonel Forde, of the 39th Foot, who on certain conditions gave up the King's service and entered that of the Honourable East India Company, is an instance of a fine soldier sacrificed to what the Company would term "expediency." Clive was so impressed with Forde's pluck and skill in capturing Masulipatam and its French garrison with a force numerically inferior to that garrison, that he brought it to notice in most special terms. The Memoir of Forde, written by a descendant, tells the story of Captain Yorke at the storming of Masulipatam, carrying a breach and several bastions at the head of his English company, and then suddenly left alone, his men having bolted in a panic, with two little native drummer-boys "beating the Grenadier march." Going back, he rallied his men, and brought them on again, but in the rush on the next bastion the two little drummer-boys, who had stood by him when his men fled, were both shot dead; while Yorke himself fell with a ball in each thigh, and sixteen soldiers.

3rd Regiments of Indian Cavalry to-day, viz., Col. James Skinner and Col. William Linnaeus Gardner. Mr. Keene's "Hindustan Under Free Lances" tells the story of these remarkable leaders of *condottieri*, the lives of some of whom embody a romance which has left its mark even to this day.

I will touch briefly on the story of three, Gardner, Boigne, and Reinhardt, respectively of English, French, and German (believed born near Trèves, but entered French army) race. William Linnaeus Gardner descended from an Irish line of soldiers (his grandfather having commanded the 11th Dragoons, and his great-grandfather helped to defend Derry), and was himself a captain in the 30th Foot. His uncle, Alan, was a very distinguished naval officer, and in 1800 was created Baron Gardner. William Linnaeus, when he took service with Holkar, married a daughter of the Nawab of Cambay. His grandson married a reputed grand-daughter of the last King of Delhi, and therefore a descendant of the great Moghul line of Tamerlane, Baber, Akbar, and Aurangzeb. The succession to the Barony of Gardner has since 1883 been in dispute, and one of the claimants is the direct descendant of William Linnaeus Gardner, and on the maternal side of two Indian princesses.

Turning to Boigne, we find that he came home with a fortune towards the end of the eighteenth century and married Adèle, the penniless daughter of the Marquis d'Osmond, a French Royalist refugee resident in England. The beautiful Comtesse de Boigne, the pages of whose "Mémoires" so many of us have, at least, skimmed, found the rich and now titled but elderly husband a dull companion, and left him to lead her own independent life. The Comte de Boigne went to reside at Chambéry, in Savoy, where his memory is still revered for his good works. Colonel Tod, of "Rajasthan" fame, visited de Boigne there in 1826, four years before his (de Boigne's) death.

The Reinhardt romance is almost the strangest of the three. "Sombre," as Reinhardt was commonly called, died in 1778, but his relict, the famous Begum Sumroo, with her stepson, settled at Sardhana, near Meerut, and maintained there the Sardhana Brigade, consisting of five battalions, forty guns, and a regiment of horse, containing 300 Europeans, at the head of which she herself took the field, finally receiving the Sardhana property as a fief from the East India Company. When she died, in 1836, she left all her property to her step-grandson, David Ochterlony Dyce Sombre.* He married a daughter of the third Viscount St. Vincent, and died leaving her his property. She married *en secondes noces* the third Baron Forester, and left to the Forester family a very large sum of money (£400,000, it is said) for the erection and maintenance of hospitals for the poor of certain Shropshire districts. With this fund are maintained two hospitals and a convalescent home, which are, I hear, now being used for the treatment of the sick and wounded of this war. When we look back on the chequered careers of Walter Reinhardt and the Begum Sumroo, it is curious to think that they were unwittingly working for the future welfare of the British soldier in this war.

The century which preceded the admission to the ranks of the East India Company's Army of the Pathan, Sikh, Punjabi and Baluch, covers a broad field of warfare of the most momentous character, on one or two incidents only of which I can touch. After our struggles with the French and the formidable power of Haidar Ali and Tippoo Sultan and our earlier wars with the Mahrattas were past,† came the expedition under Sir David Baird to Egypt and the very difficult march across the desert from Kosseir to Cairo. David Baird was among the prisoners made by Haidar Ali in 1780, the tale of whose sufferings at Seringapatam makes a man shudder as he reads it. There is a story afloat that when Mrs. Baird, David's mother, heard that the prisoners were chained two and two, she exclaimed, "Heaven help the chiel that's chained to oor Davie!" That speaks volumes

* I find that Sir David Ochterlony was, in his later years, appointed Agent to the Governor-General at Karnal, then the North-West Frontier Station of British territory in India. The Begum at Sardhana would be in his Agency, and it is not impossible that Sir David might be godfather to the young Dyce Sombre.

† We hardly, perhaps, realise to-day the hostile forces with which the Marquess Wellesley had to cope at the time when Tippoo Sultan's power was at its zenith. Lord Brougham, in his "Statesmen of the Time of George III.," Vol. III. pp. 279-285, defines them well. Tippoo Sultan had the support of the Government of France, and, in prospective, of 14,000 troops in the service of the Nizam, trained by the Frenchman, Michel Raymond. Moreover, Shah Zaman, of Kabul, was ready—following the stereotyped route *viâ* Peshawur, Lahore, and Karnal, and passing the sites of the famous battlefields of Panipat and Thanesar, the route of Alexander, Mahmud, Taimur, Baber, and Nadir Shah—to march on Delhi. To break up this possible coalition, Tippoo and the Mahrattas had to be crushed or overawed. In the school of these wars the Marquess's brother, Colonel Arthur Wellesley (the future Great Duke), learnt some of his early lessons, and won the fame that recommended him for the command in Spain.

for "oor Davie's" boyhood, and foreshadows his fine future. He was terribly wounded in the action in which he and many others were made prisoners, and when Haidar Ali's brutal myrmidons wanted to put irons on poor Baird, despite his wounds, Captain Lucas sprang forward and said he would wear two sets himself rather than that Baird should be fettered. Try a weight of 9 lbs., the weight of the Seringapatam fetter, round your feet for a few hours, and then think how you would like 18 lbs.* This terrible imprisonment lasted four years. In 1799 Sir David Baird led the storming party of 4,000 at the second siege of Seringapatam, and had his revenge. His expedition to Egypt followed in 1801. When we recollect that in 1885, despite all the preparations made for a railway from Suakin to Berber, Lord Wolseley declined to face that route for the relief of Gordon, we will appreciate the ability of Baird and the merit of the troops under his command, some of them being Sepoy regiments from Madras and Bombay, who, after a long sea voyage from Bombay to Kosseir, performed the onward march to Cairo without loss or mishap. On the other hand, native troops have on occasion proved "kittle cattle." The Vellore mutiny of 1806 is a terrible story, the redeeming feature of which was the gallantry of Colonel Gillespie, the same fine soldier who, in 1815, as Sir Rollo Gillespie, died nobly leading his men against the Gurkhas in the passes of Nepal.

A poet whom the King has recently delighted to honour, Sir Henry Newbolt, has told us in his attractive verse, which seems by its very *élan* to carry us onward on the airy wings of its loosely woven narrative, the stories of David Baird and Rollo Gillespie. We grasp the spirit and force of Newbolt's verse best when we know something of his story beforehand. Thus he writes of Baird as a prisoner :—

"Baird was bonny and Baird was young,
His heart was strong as steel,
But life and death in the balance hung,
For his wounds were ill to heal.
That was the hour when Lucas first
Leapt to his long renown;

Then Lucas speaks :—

"'Tell ye the lord to whom ye crouch,
His fetters bite their fill;
To save your oath I'll wear them both
And step the lighter still.'"

Baird stormed Seringapatam in 1799, and in Newbolt's verse thus dismisses his hostages, Tippoo Sultan's sons :—

"'For all the wrong your father wrought
Your father's sons are free;
Where Lucas lay, no tongue shall say
That Mercy bound not me.'"*

Captain Lucas died, after two years of captivity, in July 1782. We owe Sir Henry Newbolt a debt of gratitude for reviving Lucas's noble memory. The spirit of Captain Oates was in him.

On July 10th, 1806,† at 2 a.m., 1,500 native troops, many of whom had been in the old Mysore army, mutinied and attacked 400 of the 69th Foot, who held Vellore Fort, their wives and children being there with them. At 6 a.m. Colonel Gillespie, at Arcot, fourteen miles off, got news of this. He was then in command of the 19th Light Dragoons. Sir Henry Newbolt tells the story thus. Gillespie speaks :—

"'Trumpeter, sound for the Light Dragoons,
Sound to saddle and spur,' he said.
'He that is ready may ride with me,
And he that can may ride ahead.'

* * * * *

"Alone he came to false Vellore,
The walls were lined, the gates were barred.

* * * * *

"'A rope! a rope!' Gillespie cried.
They bound their belts to serve his need.

* * * * *

"And lightly swung and rightly swung
Over the gate Gillespie came.

"He dressed the line, he led the charge,
They swept the wall like a stream in spate,
And roaring over the roar they heard
The galloper guns that burst the gate.

"Fierce and fain, fierce and fain,
The troopers rode the reeking flight.
The very stones remember still
The end of them that stab by night."

* When I was in command, some fifteen years ago, at Chaman (railway terminus sixty miles from Kandahar), an Hazara ex-sepoy arrived there from Kabul. He had been arrested and put in irons for eight months. He escaped, and, traversing the Ghilzai country, reached Chaman. His leg was suppurating, the bone having been eaten into by the fetter. We tended him for some months in our hospital and he improved. I was then *ordered* to send him to the civil hospital, where in less than a month he died.

* At the St. John Ambulance and Red Cross sale to be held at Christie's in April, the sword of Tippoo Sultan, taken by Colonel the Hon. Arthur Wellesley in 1799, is to be sold. The Duchess of Wellington has received it from Mrs. Matthews, of Portumna, to whose ancestor the great Duke's brother had given it.

† Gillespie was to have dined with Colonel Fancourt at Vellore on the evening of the 9th. Urgent Government business obliged him to forego this engagement. This probably saved both him and the Vellore garrison.

Six hundred of the mutineers were killed on the spot, and most of the remainder were captured. The bulk of the 69th Foot and their women and children were saved; but in officers the 69th lost very heavily, though to Sir Henry Newbolt's version of that point we must, I think, allow some measure of poet's license.*

Just a year before this moving incident Lord Lake had made a stern effort to take Bhartpur. Four attacks were made and repulsed, the 12th Bengal Native Infantry having in three of those attacks successfully planted their colours on the top of the breach or rampart, but by not being supported had to withdraw.

The 12th Bengal Native Infantry has passed away. Lake's siege of Bhartpur is borne on no colours or list of regimental honours, as the siege resulted in failure. The "Bhartpur" that is commemorated is the successful siege of 1826, under Lord Combermere. In 1825 a deputation from Leadenhall Street waited on the Great Duke, and said, "We want a Chief who will take Bhartpur." Said the Duke, "Lord Combermere's your man." Said the deputation, "We doubt his genius for a siege." "Bless his genius," said the Duke, "I tell you, Combermere's the man." The directors took him, and within the year he took Bhartpur. We may run through innumerable engagements and sieges, Assaye, Kirkee, Koregaum, Laswari, Dieg, Asirgarh, Mahidpur,* and so on, till we come down to the battles of Maharajpore and Punniar, on December 29th, 1843, where Sir Hugh Gough and General Grey severally defeated Scindia's forces, numbering about 30,000 men competently trained and disciplined by Christian officers of European descent. Sir Charles Napier and Sir Harry Smith in their correspondence present us with a humorous picture of Gough's army so taken by surprise that Ladies Gough and Smith were seen careering about on an elephant in the thick of the bullets. Writes Sir Charles to Sir Harry: "How came the ladies to be in the fight? I suppose you all wanted to be rid of your wives? Well, there is something in that; but I wonder the women stand so atrocious an attempt. Poor things! Well, I dare say they too had their hopes!" Can we understand the animosity of Lord Dalhousie and Outram and Jacob against the genial old gentleman who could write such pleasant and kindly chaff? But Sir Charles Napier could be a Tartar.

I must lead you now to a scene, a scene of stern fight and death, with which Sir Charles was himself in part associated. The scene is in or about 1846 in the Cutchee Hills, on the border of the Marri and Bugti countries, which lie between Upper Sind and the Pishin plateau. Napier's biographers tell how an English sergeant and ten English soldiers of the 13th (Somerset) Light Infantry, Jelalabad men, veterans of Sale and Dennie, misunderstanding their orders, pushed on up a steep ascent till they were met at the top by eighty hillmen, Bugtis, Jakranis, or Dumkis, and fought with them to the death. The eleven all fell, having killed seventeen hillmen. The Baluch survivors tied a red thread on both wrists of each Somerset man and left them. Thus they were found. Sir William Napier adds: "They had done the same before (in 1840 or 1841) to the heroic Clarke, whose personal prowess and intrepidity had been remarkable." I must make the story short. Seventy years ago, in the Indian Army, "Kāhun Brown," *alias* Captain Lewis Brown, 5th Bombay Native Infantry, was a name familiar to all. He held Kāhun, the principal Marri village, for several months with 150 men, hemmed in by

* The following passage in "The Mahratta and Pindaree Campaign of 1817-18-19," by "Carnaticus" (Captain Marshall Clarke), came to my notice recently. The story is given by Captain Clarke to illustrate the evil resulting from the ignorance of the native colloquials then almost universal among the officers of the King's Service. "Had Lieut.-Colonel Fancourt, who commanded at Vellore in 1806, understood the native language, he might have profited by the information of a Seapoy who discovered the plot to him; but the Colonel and his family being totally ignorant of the language, he was obliged to have recourse to a Subahdar implicated himself in the conspiracy, and who interpreted the Seapoy's report into a piece of merriment, adding of himself that the Seapoy had been mad for years. The succeeding evening brought about the well-known calamities of the 21st July, 1806" (p. 320). Major-General Sir R. R. Gillespie was killed in 1815, in the attack on the Gurkha stockade at Kalunga. His Memoir, dedicated to H.R.H. the Prince by "the Author" (anonymous), appeared in 1816. The only copy I know is in the India Office library. To know what manner of man Gillespie was the Memoir should be read. Three noted men in India are said to have speared tigers on horseback, viz., James Skinner, Rollo Gillespie, and James Outram. "On the racecourse at Bangalore Gillespie attacked and speared a royal tiger of the largest size and most furious description. The horse which he rode on this occasion was a high-bred Arabian, and the only one that could be brought to face the tiger. This fine animal (presumably the horse, not the tiger, is meant) is now, or was lately, in England, having been sent home by the colonel as a present to His Royal Highness the Duke of York."—Gillespie's "Memoir," p. 111.

* "Carnaticus" (Captain Marshall Clarke), writing in 1820, says that at the time of the battle of Mahidpur (December 21st, 1817) the British force under Sir T. Hislop and Sir John Malcolm, amounting to 8,000 fighting-men, was accompanied by *two hundred thousand* camp-followers. About 1840 Sir Charles Napier in Sind put his foot down, reduced his own baggage to four camels, and gave subalterns one each. Even the Political Officer kept up his hundreds of camels for his preposterous camp.

the hillmen. At last he told the Marris that if they did not at once let him out with all the honours of war, he would just stay where he was for another six months. This so worked upon the Marris, whether upon their fears or their sense of humour I leave you to judge, that they agreed that he should march out with all the honours of war, and they faithfully kept their word. The Commander-in-Chief ordered the account of the defence of Kāhun to be read out to every regiment in the Bombay army (this was in 1841), and the Government of India made "Kāhun Brown" —there was neither V.C. nor D.S.O. in those days—a "Political Officer."* He became President at Baroda and died there from the kick of a horse. Baroda is somewhat fatal to Residents. Diamond dust is reported to have threatened to end the career of one Resident.

Walpole Clarke was a young cavalry officer who, with his troop, had escorted Captain Brown to Kāhun, and then went back for supplies. The Baluchis, in hundreds, attacked his small escort and annihilated them. Clarke fought and died most gallantly, so gallantly, that the Baluchis honoured him as they honoured the Somersets. Sir Francis Doyle thus concludes the Somerset men's story in his poem "The Red Thread of Honour":—

The Baluch chief speaks:—

"'Enough!' he shouted fiercely,
'Doomed though they be to hell,
Bind fast the crimson trophy
Round *both* wrists! Bind it well!'

"Then all those gallant robbers
Shouted a stern 'Amen!'
They raised the slaughtered sergeant,
They raised his mangled ten.

"And when we found their bodies
Left bleaching in the wind,
Around *both* wrists in glory
That crimson thread was twined."

—*The Red Thread of Honour.*

* At that period many a good soldier was made a Political, a fact that may palliate the cool statement made by a great Indian ex-official a year ago, before the Royal Geographical Society, that the success of every frontier military expedition which he had known was due to the ability of the Political Officer. Political Officers have often brought disaster upon the expeditions which they accompanied, as the Duke of Wellington told Lord Ellenborough after the Macnaghten and Burnes fiasco in 1841 at Kabul. The opinion of Sir Joseph Thackwell, who commanded the cavalry at the Battle of Goojerat, on this subject is thus expressed: "A solemn protest must be made against the system of hampering the Commander-in-Chief with Political Agents. Lord Gough was entangled with these political shackles. Major Mackeson, the Governor-General's Agent, controlled the movements of the Chief. Sir Charles Napier would not undertake the office of Commander-in-Chief save on the condition that he should be perfectly exempt from all control in the field. The mischief of which the Political Agents have been productive is prodigious."

Now let me relate an incident of these wars which shows that we English are in no way behind in testifying our admiration of an enemy's valour. In the fort at Hyderabad, Sind, hard by the tombs of two British officers slain at Miani and Dubba, stands a monument, the inscription on which records the death, "while bravely fighting the gun placed over his tomb," of the Ameer's soldier buried there. Whether it is the tomb of Hosh Mohammed Sidi, to whose bravery Charles Napier himself is a witness, I have not been able to decide. The body was brought in by Napier's English troops and honoured by burial side by side with Napier's English officers. In 1898 an old man, who had fought at Miani, took me to see the site of Outram's Residency, near Hyderabad in Sind, close to the left bank of the Indus. The story of Outram's escape therefrom in 1843 to the Indus Flotilla boats is told in Outram's "Life" and Sir William Napier's "History of Sir Charles Napier's Administration in Sind." The traces now of the old Residency are mere unevennesses of the ground.

As Kaye, in his "History of the Afghan War," says nothing about Upper Sind and the hill regions below Quetta and Pishin, little is known of the fighting in that quarter from 1839 to 1842 and later. Yet the famous John Jacob took a most prominent part in it. That 5th Bombay Light Infantry which sat so tight at Kāhun was then nicknamed the "Kāli Paltan," because it was recruited from small dark Bombay men. At that time the Bengal army recruited mainly in Oudh and the North-West, the Bombay in its own Presidency, and both in Rajputana. The Madras army recruited in Southern India. The old Coast army of the eighteenth century was recruited from all parts, and from all kinds and conditions. You know, naturally, that the Mutiny wiped out many of those old regiments which had in their day done gallant service. A solid stiffening with British troops was, as a rule, essential to the best exercise of their prowess. On the other hand, at Lake's siege of Bhartpur, it is a positive fact that Bengal Sepoys planted themselves on breaches which British regiments had failed to reach.*

The Madras and Bombay armies rarely, if ever, made any difficulty about serving overseas. The Bengal gave much more trouble in this respect, though it is recorded that they served

* The Bhartpuris are Jāts, and many think the Jāts are gipsies. Knowing as we do the gipsy's love, not for a walled city, but for the life of the open country, this gipsy theory about the Bhartpuris must be regarded as illusory.

in Java and Isle de France. But only *batta* reconciled them to Sind and Trans-Sutlej service, and to Burma in 1852 they refused to go. This spirit is now dead or dormant in the Indian Army and in India. As we know, almost all classes of Indians now visit Europe freely, and the present war proves that the Indian soldier will go anywhere and do anything. When duty spares them from the theatre of war in France, they may occasionally be seen dining at the Carlton.

I am afraid I have said scarce a word about the long First Afghan War, so full of incident, romance, and deeds of derring-do. The defence of Herat by Eldred Pottinger took place in 1836, and he it was who, with John Colpoys Haughton, had such a marvellous escape from Charikar in November 1841. "We welcomed them as men risen from the dead," wrote Lady Sale. The storming of Ghazni, in which Lieut. Henry Marion Durand played a notable part, the defence of Jalalabad, the vicissitudes endured by the Kabul captives and the Ghazni prisoners, the fates of Burnes and Macnaghten, the terrible scene of which Lady Butler's "Remnant of an Army" is a speaking memento,* and finally the revenge of Nott and Pollock; these are some of the memories of that war. The well-known Chaplain-General Gleig said of the 13th Somerset Light Infantry, who served from start to finish of the war (that is, for four years): "At the end they were as good as any Afghan on a hillside."†

Those words often come back to me when I read the accounts of the frontier fighting in the Tirah and Momand countries in 1897-98. Hillmen or Alpine troops are not made in a day. If you will walk across the Alps from Briançon to Fenestrelle, you will see how the French and Italians train their Alpine troops. Some of the French Alpine troops have been fighting on skis in the Vosges, and Germans also. We have none so trained, the result being that when our troops are ordered on such service they require, like our early Territorials, six months' training before they know their work.

When we go back to the momentous period of the Sikh, Burmese and Persian Wars, and the Mutiny, between 1845 and 1859, never-to-be-forgotten names rise up before our memories, to wit, Herbert Edwardes, Harry Lumsden, Henry Norman, William Hodson, Hugh Gough, Charles Napier, Sydney Cotton, John Nicholson, James Outram, Henry Havelock, Harry Smith, Colin Campbell, Neville Chamberlain, George Broadfoot, Henry and John Lawrence, and last, but not least, the revered veteran who passed away last December in the midst of Sir John French's army, Field-Marshal Lord Roberts. Gujerat, Chillianwala, Sobraon, must be passed over in silence. That fine old Indian soldier Sir Henry Green who with Jacob crushed the Baluch freebooters and charging with 300 Sind Horse routed 1,500 Afghan cavalry at Gujerat, in 1858 marched alone with the lawless Kelat troops right through the Bugti-Marri country, a dangerous experiment, not a tribesman, however, daring to touch him, and brought back the one gun which "Kāhun Brown" had been unable to carry away with him when he marched out with the honours of war. Sir Henry Green, twenty years ago, sent me a copy of a most interesting report which he had sent to Lord Wolseley on his experiences in the Sikh wars and frontier warfare. Green and Wolseley served together in the trenches before Sebastopol, and were lifelong friends. Green and Jacob served together for fifteen years or more on the Upper Sind frontier, and Green just got back from that Bugti-Marri march in time to see his old friend breathe his last. There are two men at whose grave or monument the natives of India still make obeisance. They are John Nicholson and John Jacob. Outram and Jacob carried our arms into Persia in 1856. We little foresaw then German influence at Baghdad. In 1890 I met the first German sent to spy out Baghdad, M. Richarz.* He was appointed

* I am informed by the descendant of an officer killed in the massacre of Elphinstone's army that Dr. Brydon, the one man who escaped, owed his life to carrying a copy of *Blackwood's Magazine* in his helmet. It broke the blow of an Afghan tulwār. Lady Butler depicts Brydon bareheaded.

† It is Harry Lumsden, of the Guides, and his brother Sir Peter, who speak so highly of Sir Colin Campbell as a Frontier leader. That fine soldier who declined the Viceroyalty of India, Field-Marshal Sir Henry Norman, was in those days—*i.e.*, about 1850—on Sir Colin's staff. These are the words of Lumsden's biographer: "In all retirements he stuck doggedly to the rearguard until he saw the last of his column safely out of danger." In the Tirah Campaign Sir Richard Westmacott and Colonel John Haughton acted up to that maxim, and won honour accordingly. If Colonel John Haughton's gallant death had taken place more directly under the eyes of the Nation and the War Office, he would, I venture to believe, have been awarded the Victoria Cross after death.

* We met at Karachi on the Messageries-Maritimes boat, and travelled home together to Marseilles. He told me he had been there two years, engaged in archæological work, having a steam-launch of his own. He was an excellent pianist, and fortunately the M.-M. piano was a good instrument. His conversation left the impression on my mind that the British Resident at Baghdad was a "slacker," and the Russian Agent an active intriguer among the Arabs. The *Times* of March 10th, 1915, has an interesting leader in this connection on "A Picture of German World Politics," and No. 29 of the *Times* "History of the War" still further enlightens us. Lastly, an India Office *communiqué*, of March 19th, 1915, sheds light on the intrigues of German consuls and traders in Persia, and on Persian intrigues in which the German Legation at Teheran are clearly implicated.

German Consul-General there in or about 1891. He did not foresee that he was paving the way for a British protectorate over the Shatt-ul-Arab district, which General Sir A. A. Barrett's force has now occupied, and to which the Viceroy of India has promised, in the near future, a more "benign rule."

The "Napier" antagonism burnt so strong in Jacob's breast that it extended to the two Napier Baluch Battalions, now the 127th and 129th. If Jacob had had his own way, he would have had them disbanded in 1856. They rewarded the Commander-in-Chief in Bombay for his indignant refusal to do any such thing that very same year in Persia, and afterwards throughout the Mutiny, by rendering to the Government the most loyal service. Lord Napier of Magdala specially recognised the services of the Baluch Battalion at Delhi, and in Oudh and Rohilkhand, and again had them under his command in the Abyssinian expedition of 1868; and Captain Griffith, of the 61st Foot, in his "Mutiny Diary," sums them up in these words: "The Belooch Battalion, a savage-looking lot of men, who, however, did good service and fought well." They are now fighting very well in France. The laurels which they have already won are a V.C., the first ever won by an Indian soldier, two Indian Orders of Merit, and four Distinguished Conduct Medals. Of these seven soldiers, five have been killed, and one, Private Khudadad, V.C., very seriously wounded.

Among my private papers is a remarkable story connected with the first Sikh war. On the night of December 22nd, 1845, the wife of a well-known London clergyman (his name is in the Clergy Lists of that period) dreamed that she saw the postman hand to her a black-edged letter containing her son's commission. Her son had very recently joined a regiment of the Indian Army. On the morning of December 23rd she told her husband of her dream, and later in the day other friends. In due course the father and mother heard that their son had been killed on December 22nd, 1845, in the very first action of the first Sikh war, that of Firozshah. It seems clear, from an examination of dates and having due regard to the comparative slowness of communication between Lahore and London in 1845, that not even a rumour of the coming Sikh war could have reached the ears of the parents by the night of December 22nd. For the rest, I leave the case in the hands of the Psychical Research Society.

In the sixties of the last century the Presidential armies of India began more to conform themselves to that composition and classification which is now in vogue. Details on such a point as this must really be left to official publications; but I can assure you that a study of the brief historical headings which now appear in the Indian Army lists will well reward the reader. We have come to the era of the Gurkha, Pathan, Sikh, and Punjabi, an era which for the three races last named may be said to date from 1850. The Gurkha entered our service from 1815 onwards—in short, immediately after the conclusion of the Nepal War, in which the gallant Sir Rollo Gillespie was killed, and Sir David Ochterlony, a close friend seemingly of the Begum Sumroo, won his laurels. It is evident from Jacob's aversion to them that Pathans had found their way into the East India Company's service some years before his death. Jacob detested them, and many others have denounced them. They claim an Israelitish origin. Moses pronounced the Israelites "stiff-necked"; the Pathan does full justice to his reputed forbears, and makes none the worse soldier for it. Could Jacob—not the Patriarch, but the famous Frontier officer—have foreseen that Afridi Maliks would in 1915 give garden parties in the Islamiya Garden at Peshawur, and invite thereto the Chief Commissioner of the North-West Frontier Province and the *élite* of the local society?

For those who desire statistics about the Indian Army there is an excellent article by Mr. Vivian in the January number of the *Asiatic Review*, and another in the February number of the *National Review*. All space permits me to say is that when war broke out the British Empire could look to a regular Indian army 160,000 strong (British troops excluded), consisting of thirty-nine regiments of cavalry, about 140 battalions of infantry, thirteen mountain batteries, and three corps of sappers and miners. To these are to be added 39,000 volunteers, 22,000 Imperial Service Troops, and 35,000 Indian Army reserve. The duty of the Volunteers, composed of Europeans, Eurasians, and Parsis, is to preserve peace in India. The rest serve in India or abroad. Pathan, Punjabi, Gurkha, Sikh, Mazbi, Dogra, Rajput, Maratha, Jāt, Garhwāli, Hazara, Baluch, Mhair, Brahman and Mussulman of Hindustan, and inhabitants of Kashmir, the Carnatic and the Deccan—all these races are represented in the Expeditionary Force under

General Sir James Willcocks now fighting in France.

The Russian attack on the Afghans at Penjdeh, on March 30th, 1885, is said to have given rise to the idea which has matured in the fine force known as the "Imperial Service Troops"; and it was also about that time that it was decided to confer honorary rank in the British Army upon the most distinguished of His Majesty's Indian subjects. The Imperial Cadet Corps, formed under H.H. Sir Pratap Singh, is an Officers' training corps for the princes and nobility of India.* It fell to the lot of the late Field-Marshal Sir George White, as Commander-in-Chief in India, to amalgamate the three Presidential armies in one.

Among the native attachés who accompanied the Afghan Boundary Commission of 1884–86 were some of the picked men of the Indian Army, viz., Hon. Colonel Sir Mahommed Aslam Khan, Commandant of the Khyber Rifles and an Hon. A.D.C. to the King, who died not long ago, and Risaldar-Major (afterwards Hon. Captain) Baha-uddin Khan, of the Central Indian Horse, and others. We count now among the hon. major-generals and field officers of the British army and hon. aides-de-camp to the King several reigning princes of the Indian Empire, whose loyalty and ability His Majesty has desired to recognise, and it has for some time been customary to confer the honorary rank of captain or lieutenant on senior officers of the Indian Army when they retire on their pensions.

The *Times* includes in its excellent "History of the War" two ably written Parts (Nos. 22 and 29 of Vols. II. and III.) devoted to the Indian Army as it is seen in France, Egypt and the Persian Gulf to-day.† Two months ago it was stated that the Indian Expeditionary Force in France, not a large one, had had 10,000 casualties, including 228 British officers. One battalion, I know, had by Christmas lost 75 per cent. of its original effective. In our last important war, in South Africa, the only Indians we sent there were hospital bearers and orderlies and ambulance tonga drivers. They did admirable work. Since then the formation of the Indian branch of the St. John Ambulance Association has been carried out.* I laid my scheme for this, in 1900, before the late Viscount Knutsford, and, at his request, undertook the task of organising and establishing the branch. This, thanks to help from many good friends, I was enabled to do, as Lord Knutsford publicly acknowledged in a speech in the House of Lords on July 21st, 1910.† The Indian Army has greatly profited by this during the present war, in which we have loosed all that can be spared of the strength of our magnificent Indian Army and Indian Empire against our foe. In self-defence we could do no other. On December 8th, Sir John French telegraphed to Sir James Willcocks: "I owe the Indian troops a deep debt of gratitude for the splendid services they have rendered," and after the fighting from March 8th or 9th to the 14th, near Neuve Chapelle, both Sir John French, in his telegram to the Viceroy of India, and Lord Kitchener, in his speech in the House of Lords, testified to the fine behaviour of the "I.E.F." Humbler but not less telling evidence appeared in the Press. The Indian Army will now take its place as an Imperial Force, a position for which it has for more than a century and a half been vigorously qualifying. When our naval and military leaders first met the French in India, a blow was struck for the Empire. When Indian troops landed in Egypt (1801 and 1882), and in Malta in 1878, they foreshadowed the part they play to-day. When they mingled in 1900 among the army of all nations at Peking, they were serving a phase of their apprenticeship. The Germans, as insolent as they are ignorant, called them "coolies." An Indian chieftain and soldier of the purest

* In the discussion which followed this paper attention was drawn to the necessity for establishing in India a Military and a Staff College, similar to those at Sandhurst, for the education and training of Indian officers, if they are to become "leaders of men" equal to our British officers. To some such result this war seems likely to lead. Our public schools have been a tower of strength to the Army at this juncture, and the Prime Minister himself paid in Parliament a just tribute to the Universities of Cambridge and Oxford as military training schools. India has her Aitchison, Mayo and Aligarh Colleges, which may well begin this work which the future military colleges of India will complete. It will doubtless be open to the great Princes or groups of Princes of India—Rajput, Sikh, Mahratta, Mussulman—to found their own military colleges, the instructors being, at the outset, British.

† Our operations in the Persian Gulf have led not only to fighting on the Shatt-ul-Arab, but also to war between Arab adherents of the British and Turkish Governments (in these Captain Shakespear lost his life), and to a Turkish invasion of neutral Persian territory near Ahwaz, where the Turks were ultimately, it seems, repulsed. They aimed at the oil-pipe line, and it seems to be thought in some quarters that they cut it.

* To give an idea of medical provision a century ago, it is recorded by "Carnaticus" that "there was great want of medicines, scarcely a bit of dressing-plaster, and no amputating instruments, except those belonging to individual surgeons. Out of every three amputations two died in hospital."

† Sir Steuart Bayley (whom I had consulted about this project) very kindly invited me to lecture on this ambulance scheme in or about November, 1900, before the Royal Society of Arts. I have always regretted that I was unable to accept this invitation.

Rajput blood never forgot that word "coolie," and he and his brother Rajputs are now wiping it out on the battlefield of Northern France. When they landed at Marseilles, Pathan and Gurkha pipers played the "Marseillaise" through the streets of the home of that famous patriotic song. Sir James Willcocks will not impossibly march his Indian force to the strains of the same pipes down the "Unter-den-Linden" and past the palace of William the Second before they return to India. The German Emperor, throwing down his gage of war, and trusting to sow discord, wove the web of "Peace" among contending factions, and drew the bond of union closer between each unit of our Empire. He relied on his compact with the Turk to alienate from Great Britain her Mohammedan millions. He has but strengthened the ties that attach them to us. The commanding officer of a Mussulman regiment wrote to me from India, "Our men are dying to have at the man who seduced Turkey." Our great departed soldier, Lord Roberts, sees his cherished scheme of a National Army practically realised. As the Dean of Manchester said, the war has made class respect class, and we know what its effect has been upon "Party." When we glance backward over the history of our Empire during the past sixty years; when we reflect that some heedless indiscretion or arbitrary impulse might have raised up in Canada, New Zealand, or Australia a second Washington or Franklin; when we recall the Mutiny, the war in South Africa, and the slenderness of the tie that forty years ago bound the Dominion of Canada to the Crown, we can but rejoice and be thankful that a glorious union now animates the peoples of our world-wide Empire, and that our King commands the services of a Navy and Army which in themselves are the mightiest witnesses to our unity. And let me suggest one other reflection. If in the eighteenth century we won India from France and in the nineteenth century safeguarded it from Russia, in this twentieth century we hail both as our trusty and valued allies in the stubborn task of teaching the Teuton and the Turk their true sphere.

The movement of a division of the Indian Army to Mesopotamia, a country rich alike in soil and in Biblical tradition, is an event of high significance, whether it be regarded as a step towards that hegemony of the Mohammedan world to which Great Britain has some authority for aspiring, or whether it simply portends an annexation of territory. We must remember that the Turks looted Kerbela of two millions sterling. The British Empire has guaranteed the protection of the Holy Shrines of Islam, and that guarantee embraces Kerbela as well as Mecca and Medina, and the Shi'ah as well as the Sunni. Constantinople plunders the Shi'ah without scruple. The problem of the fate of the remnant of European Turkey and of the Dardanelles is not for discussion here. The best future for Mesopotamia is that it should be joined to our Empire, and colonised by some of the vast surplus Mussulman population of India. Sir William Willcocks, an Englishman, has projected a scheme for restoring its system of irrigation; let the English race administer it. Indian emigration is one of the crying needs of the day. Mesopotamia and Southern Persia will surely commend themselves to the notice of the emigration office of the Indian Government. We cannot, I think, do better than reward the gallant ranks of the Indian Army—whether commanded by Sir William Willcocks's brother in France, or by other generals elsewhere—with jaghirs and grants of land in the fabled home of the first Parents of Mankind.

DISCUSSION.

The Chairman (The Right Hon. Viscount Bryce, O.M., D.C.L., LL.D., F.R.S.) said the audience had listened to an exceedingly interesting and suggestive paper. Colonel Yate certainly had had a worthy theme for his large and recondite knowledge, because the story of the Indian troops was inextricably associated with the whole romantic and varied history of British rule in India. The paper suggested a great many subjects upon which discussion might turn, and opened up many vistas, both political and military, which it was not possible at the present time to follow. Colonel Yate had pointed out what he (Lord Bryce) thought was one of the most interesting things in Indian history and in British history, viz., the gift which British people seemed to have possessed, perhaps beyond those of any other European race, of getting into touch with the natives of another country and of another speech—even when they did not fully understand that speech—and of being able to secure their loyalty and attachment, the gift of entering into their hearts and feeling with them and for them, and showing themselves apt leaders of brave men. Colonel Yate had also pointed out what a magnificent training-ground the experience of India was for many great soldiers. Time had not permitted him to speak of the early career of Sir Arthur Wellesley; but everybody knew that the experience which Sir Arthur had in India, and

the opportunity which India gave him of displaying his great gifts, made him the man most fit to be chosen at the darkest hour of England's fortunes—when the power of Bonaparte seemed to be overspreading the whole Continent—to take command of our troops in the Peninsula, and to begin that career of conquest which ended at Waterloo. During all the years from Clive's time downwards there was arising in the Indian Army that spirit of loyalty and of devotion to its leaders, as there was arising amongst us and amongst our soldiers that appreciation of the noble qualities of the Indian troops, which had now found a most remarkable illustration and display in the events of the last eight months. Those events had been by far the most remarkable events in the whole long and brilliant history of the Indian Army. It was impossible to conceive a more striking instance of the loyalty and attachment of the people and princes and troops of India to the British Empire, than was displayed when that spontaneous offer, which touched us all, came in the month of August last. Since then, what deeds of brilliant valour! The Indian troops had shown themselves worthy compeers of our own troops and the troops of our Allies, not only in courage and devotion, but in endurance of hardships, and in unfailing loyalty. It was one of the redeeming incidents of a time so full of sorrow for all, that that spirit of attachment should have been shown by the people and princes and troops of India to the British Empire. This was a new tie, and perhaps the deepest and the most binding of all ties, that would hereafter unite Great Britain to India; because it showed that the efforts Great Britain had made in discharging worthily the duties which Providence had laid upon it, and the spirit in which Britain had tried to discharge those duties, had been appreciated in India. On the other hand, it showed that the people of India recognised that the future had in store for them, as for us, a closer connection than ever before, based upon the endurance of common suffering and upon the devotion to a common cause. It might reasonably be hoped that this country's relations to India would rest upon a surer foundation of mutual affection and respect hereafter than it was possible it ever could before, and that was one of the compensations for all the struggles which we were now called upon to endure. There was every reason to believe, and to hope, that there would henceforth be a feeling of common interest and pride in the glory of the Empire and a common devotion to its welfare.

Sir Steuart Colvin Bayley, G.C.S.I., said there were one or two points on which he could have wished Colonel Yate had dwelt a little longer. As it was, however, he had given a delightful paper, beginning with war and ending with war, in the midst of it being a great deal of what the Scotsman said of a sheep's head, "Good confused feeding." One point which he wished the author had made a little more of was the early beginning of the Indian Army in the different Presidencies. He himself had looked up the subject when studying the history of Lord Clive a few years ago, and he got to be interested in it very much indeed. As the author remarked, the Sepoys with whom Clive had to fight the French were a very nondescript lot; they were very little better than the soldiers of the native Courts. They were armed better, because we armed them; and occasionally supplied a non-commissioned officer to drill them. Later, English officers also commanded them in the field. They were men who had taken up a military life, and they came in the following way: A jemedar, or any partisan leader who had collected a hundred men or so, would bring them and enlist them as a separate company, and they remained separate companies. On one occasion in Madras no less than 600 came over from the defeated enemy with their native officer. They appeared to have thought that Clive was in the ascendant, and that their own commander was decadent, and, therefore, they joined Clive in a body. In fact, they resembled the *condottieri* of the Italian wars and the followers of Dugald Dalgetty. That was the way things were managed as long as Clive was fighting the French in Madras. When he went to Bengal, in 1757, he changed things a good deal. He landed in January, and proceeded to form a regiment. Instead of having individual companies, he formed what was called the Red Regiment. He drilled them with European non-commissioned officers, clothed them in the same uniform as his own soldiers, gave them British arms, and British officers to command them in the field. The first battalion numbered a thousand, and included Pathans and Rohillas, Rajputs and Jats, but mainly up-country Mussulmans. Clive raised another battalion of the same size in August of that year, and a third battalion before the year was over. He left Bengal and came back six years afterwards as Governor of Bengal. By this time there were twenty of these battalions. He then took a larger and very much more important step. The British officers up to that time in the Bengal army had been in one general list, and were temporarily attached to different regiments for particular purposes in the field. Clive did away with the general list, and broke it up into regimental lists; that was to say, an officer was attached to a native regiment during all his service. Then he brigaded those native infantry regiments with a due proportion of other arms of the service, each brigade being under a general officer. That was the system which Clive founded in Bengal, and which

lasted for about a hundred years until the time of the Mutiny. That system produced a class of officer of which Colonel Newcome, in Thackeray's book, was a typical example. He (the speaker) did not object to Stringer Lawrence being called the grandfather of the three Presidential armies; but he did think that Clive was the father of the Bengal Presidential army.

Colonel Sir Thomas H. Holdich, K.C.M.G., K.C.I.E., C.B., D.Sc., called attention to one point on which the author had not insisted, and which demanded a little more attention than it received in the present day, when the public at home desired to know as much as possible about the Indian Army. He referred to the extraordinary admixture of nationalities of which that army was composed. If Roumania, Italy, and Greece were to join with Belgium, France, and England in the present great war, there would not be amongst the Allies quite as large an admixture of totally distinct nationalities as existed among the Indian Army at present serving with them. They were not only distinct nationally, but they were distinct in their idiosyncrasies and in their social customs. There was a tendency to pay attention to the picturesque side of an army, and to admire, perhaps in a greater degree than was fair to the rest, certain regiments, or certain groups of regiments, which more or less filled the public eye. In the British Army he thought that was the case with the Highlanders. They really occupied a good deal of public attention when there was no war going on. Why that should be so he could not quite understand. It was not because the men were Scotsmen, because very often they were not; but there seemed to be something about their dress which attracted everybody's attention to them, and made them popular heroes wherever they went. It was the same more or less in the Native Army. There was a notion that the Indian Native Army consisted of Sikhs and Gurkhas. Sikhs and Gurkhas made very fine soldiers, and no doubt were to a large extent the backbone of the fighting strength of the Indian Army; but they did not compose the whole army. It was therefore with very great pleasure that he had heard what the author said about his own particular section of that army, the Baluchis, and that he had heard directly and privately from the seat of war of the excellent performances and fine fighting qualities of the Mahrattas and Rajputs. It was a satisfaction to think that those perhaps rather unconsidered units in the great Indian Army were getting a little bit of their own back again. They had been good fighting men in their time, and their traditions were evidently still with them. He entirely agreed with Lord Bryce in thinking that after the war all India, both military and civil, would be knit together in a new bond of loyalty to the British Government, which would last as least as long as those hardy warriors who had served so well in the trenches. These men, when they returned to their native villages and sat in the market place, or under their own peepul trees, would tell their children and their children's children of the great deeds done while they were fighting in Flanders shoulder to shoulder with the Sahibs.

Colonel C. E. Yate, M.P., C.S.I., C.M.G., said reference had been made in the paper to the Imperial Service troops and the Imperial Cadet Corps, and he would like to explain what they really were. The Imperial Service troops might be termed the outward and visible sign of the loyal desire of the great ruling chiefs of India to take their proper share in all actions for the defence of the Empire. Those troops were raised by the ruling chiefs, and were mostly composed of the men of the Native States to which their officers also belonged. They differed from regiments in the Indian Army in having no British officers. All present knew that each regiment of the Indian Army had, as a rule, an establishment of fourteen or fifteen British officers as well as seventeen or eighteen native officers. The Imperial Service troops practically had only the Native officers. Nothing had been more completely proved during the present war than the necessity of a large establishment of trained British officers with all Indian regiments. Without the leadership of scientifically-trained British officers the Indian was helpless in France and Belgium. He did not wish to see British officers posted to Imperial Service regiments, but if the Imperial Service troops were to form a permanent part of the Imperial army they would have to be put in the same position of equality, so far as the training of their Indian officers was concerned, as British and Indian regiments. With regard to the Imperial Cadet Corps, he hoped to see it very much more than simply a training corps for the princes and nobility of India as described by the author. He hoped to see, in the future, every State in India contribute its due and proper proportion of Imperial Service troops on an equal basis with regard to its revenues and its treaty obligations with the British Government. He looked forward to seeing Indian cadets from the Imperial Cadet Corps drilled and trained in an Indian Sandhurst, as were English cadets in England; after that they might be gazetted out as second lieutenants to the Imperial Service regiments and be eligible to go up with British officers to the same boards of examination and exactly under the same regulations; to be examined at the same time for promotion; to be admitted on equal terms to the Staff College at Quetta; and

to be sent through the varied courses of instruction in India on perfectly equal terms with British officers. We should welcome them with open arms as loyal comrades in arms; but if the Imperial Service troops were to take their proper place in the Imperial defence, it was necessary that their Indian officers should be as well trained as British officers. He hoped the Indian Government would take up the question in all seriousness.

THE RIGHT HON. SIR HENRY MORTIMER DURAND, G.C.M.G., K.C.S.I., K.C.I.E., in proposing a vote of thanks to the author, said he was in France the other day and went to see the Indian wounded in one or two hospitals. The cheeriest and most amusing fellows he saw were two wild frontiermen, Mahsud Wazirs. They were in the highest spirits and extremely pleased with themselves. He said to one of them, "I suppose you know that your tribe is fighting against us at the present moment." The man roared with laughter, and said, "No, sahib, are they? The blackguards!" And then, "Sahib, are they putting up a good fight?" As to the Imperial Service troops, he himself was responsible to some extent for the fact that they had not any British officers. It was thirty years ago, after the apparent imminence of war with Russia, and the great display of loyalty which was shown by the Indian chiefs of that time, that the idea of forming corps of Imperial Service troops was brought forward. He was with the Government of India at the time, and the idea was not only to raise a supplemental body of good troops out of the rather loose, undisciplined levies of the chiefs, but to afford an outlet for the martial spirit of the Native States. Therefore it was specially laid down that there should be no officers except those from the Native States themselves. But nobody then anticipated that those Imperial Service troops would be called upon to fight the Germans in France. He was sure the Society and all present were very grateful to Lord Bryce for being so good as to spare time from his very numerous engagements to preside at the meeting, and for making the speech to which they had listened with so much interest.

The resolution was seconded by SIR STEYNING W. EDGERLEY, K.C.V.O., C.I.E., and carried

THE FOREIGN POPULATION OF MILAN AND LOMBARDY.

From some statistics lately published in a Milanese journal it appears that the foreign population in Italy has increased about one-third since 1881. Amongst the various regions of Italy, Lombardy contains the largest alien population, whilst about 60 per cent. inhabit Milan.

The following show the relative number of foreign inhabitants from 1881 to the present time:—

Year.	Foreign Population in		
	Italy.	Lombardy.	Milan.
1881	About 60,000	12,254	5,641
1901	„ 61,600	11,947	7,761
1914	„ 80,000	17,258	10,110

The foreign population of Milan has increased at the rate of about 2 per cent. every year between 1881 and 1901, and 3 per cent. during the last thirteen years.

Respecting nationality, it is estimated that 90 per cent. are Europeans, 79 per cent. being natives of the following four countries:—

Switzerland	2,598
Austria-Hungary	2,142
Germany	2,129
France	1,033
Total	7,902

The number of English residents in Milan does not exceed 426.

MOVEMENT OF SHIPPING AT MARSEILLES, 1914.

The Port Authority of Marseilles has published the following statistics of the movement of shipping during the past year. These figures show clearly a considerable falling off in the traffic of that port which has taken place since the outbreak of the war. The number of ships which entered during the year ending December 31st, 1914, was 7,234, with an aggregate tonnage of 8,992,977, with 5,203,876 tons of merchandise and 249,626 passengers. The sailings were: 7,201 ships, of an aggregate of 8,961,930 tons, 2,999,579 tons of merchandise and 216,076 passengers. The total movement (arrivals and sailings) for the twelve months was, therefore, 14,435 ships, 17,954,907 aggregate tonnage, 8,202,955 tons of merchandise and 465,702 passengers. This shows a decrease of 2,843 ships, with an aggregate tonnage of 3,135,913, 1,644,600 tons of merchandise and 11,468 fewer passengers, as compared with the traffic during 1913.

It may be observed, however, that the returns for the first six months of 1914 show an increase of 118 ships, with an aggregate tonnage of 551,000 and 48,500 tons of cargo; so that, taking this into account, the total decrease due to the war may be estimated at 2,961 ships of 3,686,913 aggregate tonnage and 1,693,100 tons of cargo. These figures do not include the number and tonnage of the vessels chartered by the Allies for the transport of troops and war material, the landing of which was the cause of great activity at the port, particularly during the months of August and September last year.

MANUFACTURE OF CONCENTRATED APPLE CIDER IN AMERICA.

The specialists of the Fruit and Vegetable Utilisation Laboratory of the United States Department of Agriculture have completed arrangements for a commercial test of the recently discovered method of concentrating apple cider by freezing and centrifugal methods. As a result a cider mill in the Hood River Valley, Oregon, has undertaken to manufacture and test on the retail market 1,000 gallons of concentrated cider, which will represent 5,000 gallons of ordinary apple cider with only the water removed. The new method, it is believed, makes possible the concentrating of cider in such a way that it will keep better than raw cider, and also be so reduced in bulk that it can be shipped profitably long distances from the apple-growing regions. The old attempts to concentrate cider by boiling have been failures, because the heat destroys the delicate flavour of cider. Under the new method nothing is taken from the cider but the water, and the resultant product is a thick liquid which contains all the apple-juice products, and which can be restored to excellent sweet cider by the simple addition of four parts of water. The shippers and consumers, therefore, avoid paying freight on the water in ordinary cider. In addition, the product, when properly barrelled, because of its higher amount of sugar, keeps better than raw cider, which quickly turns to vinegar. The process, as described by the specialists of the Department of Agriculture, consists of freezing ordinary cider solid. The cider ice is then crushed and put into centrifugal machines such as are used in making cane sugar. When the cider ice is whirled rapidly the concentrated juice is thrown off and collected. The water remains in the machine as ice. To make the concentrated syrup, the cider mill must add to its equipment an ice-making machine and centrifugal machinery; so that the process is not practicable on a small scale. The specialists are hopeful, however, that the commercial tests to be inaugurated will show that it will be possible for apple-growers to concentrate their excess cider and ship it profitably to the far South or to other non-producing regions. The specialists also believe that it will enable apple-producers to prolong the market for cider.

RECENT INCA AND PRE-INCA DISCOVERIES.

The researches and travels about Cuzco, which are being pursued with considerable energy and interest by American antiquarians, and which have brought to light not only Inca but also pre-Inca remains, encourage Professor E. A. Ross to anticipate that at no distant period Cuzco will become a great goal of pilgrimage like Rome, Jerusalem and Cairo, and make the fortune of a Cook who could organise a good tourist service.

Since the discovery by Professor H. Bingham, of Yale, of the wonderful stone city of Machepicchu, 2,000 ft. above the River Umbamba, at a point about two days' journey from Cuzco, much discussion has arisen among the expert antiquarians of the latter city as to the aboriginal remains of this region; for it has been revealed that of these pre-Inca times the Incas themselves knew nothing. Dr. Giesecke, the American rector of the University of Cuzco, has travelled altogether more than 10,000 miles in quest of relics of the past, and, interesting as the finds are, the Doctor declares he and his companions have not done more than scratch the surface. Portions of fourteen palaces of Inca rulers line the streets of Cuzco, and much of the walls of the Temple of the Sun has been incorporated into the Church of San Domingo. These walls are of finely-cut blocks laid in courses without cement. It has often been said that the joints in the walls will not admit the point of a knife blade or needle being inserted between the great blocks, and the microscope shows that the stones were wrought with tools of champi, an alloy of copper and tin.

The vast fortress above Cuzco with its stupendous stonework belongs to a period long before the sun worshippers existed. They are supposed to be in all probability monuments of the same civilisation as those at Tuahuanacu, a few miles south of Lake Titicaca, at an elevation of 12,000 ft. Here lie the ruins of a city of a million inhabitants, the existence of which is accounted for by the idea that it dates from a period when the Andean Plateau was some thousands of feet lower than now, and thus enjoyed a milder climate. Three hours' ride from Cuzco is Chinchero, an Indian town, whose plaza occupies the site of a great Inca palace, the niched side-wall of which is still standing. Below slope royal gardens surmounted by numerous seats, stairways, and passages, cut with beautiful precision in the living rock. Here, no doubt, were wont to sit the Incas while they took their ease and feasted their eyes over the abundant and picturesque panorama. The remote valley is a peephole into the old simple life of mankind before the advent of trade and requirements and letters—the life of Egypt, Babylonia, of the Hittites and Etruscans, before ever there was Jew or Greek or Roman.

ENGINEERING NOTES.

The First Steel Manufacture in Australia.—Amid the din of war it is satisfactory to know that Australia was helping last month to increase the world's supply of steel. Mr. Paull, an expert from Scotland, a few years ago was employed by the New South Wales Government to report on the matter, the result of which has been the completion of the works in Newcastle, New South Wales, run by the Broken Hill Steel Proprietary Company's works. It is hoped that, notwithstanding the high price of labour, the local importation of iron ore will enable the work to be carried on profitably. It is understood that the South

Australian Government has already accepted a tender from the Company for the supply of 2,000 tons of 60-lb. steel rails, and 140 tons of fish-plates. The rails will be manufactured on the basic open-hearth method, and the Sandberg process applied. In connection with the utilisation of some of the large iron-ore deposits in the same State, it is interesting to note that a shipment of 2,800 tons of ironstone was recently dispatched to the Company's works at Newcastle. The ironstone was obtained from Iron-Knob, some forty-one miles from Port Augusta, where is situated the largest deposit in that State. This is contained in two great ore-bodies known as the Iron-Knob and Iron-Monarch, the latter being the larger of the two. The ore from the Iron-Knob has, during the last twelve years, been used by the Proprietary Company for fluxing purposes at the smelting works at Port Pirie, and its average content of metallic iron has been found to be over 68·5 per cent. The extent of the deposits has not yet been actually determined, but on the assumption that the average depth of ore is no more than 100 feet, it has been calculated that over 21,000,000 tons of ore are available.

The Failure of the Panama Canal Crane.—The Panama Canal Commission decided some time ago to purchase two large floating cranes. These cranes were intended to handle such heavy loads as the largest dock-gate leaves. They would have to meet the needs of the Navy Department and be capable of lifting any weights which have to be moved in connection with the repair of warships, or the heaviest guns to be mounted on the Canal fortifications. The possibility of the cranes being required for the wrecking work on commercial vessels led the Commission to decide on two cranes of 250 tons capacity each. On January 13th, 1913, four tenders had been received. These were the Deutsche Maschinen Fabrik A.G., of Duisburg, Germany, £171,000; the Werf Gusto, Holland, £192,000; Cowans, Sheldon Company, England, £230,000; and the Welman-Seaver-Morgan Company, U.S.A., £300,000. The contract was finally awarded to the German firm. The crane consists of a tower on which is mounted a revolving jib 140 feet long, weighing 165 tons. The cranes, complete as to hull and superstructure, were towed out to Colon from Emden, the jibs being shipped separately. The first crane left Emden in April last, and was seventy-four days on the voyage owing to bad weather. Tested on December 1st with a 120-ton load, which was not even out to the specified distance, the jib collapsed. Fortunately only one man was injured, but the damage is estimated at £25,000 and will take six months to repair. In commenting on the accident, a writer in *Engineering* expresses the opinion that some lateral stress, caused by wind or inaccurate erection, was not provided for. In connection with the construction of the Canal an Act was passed restricting the purchase of material and equipment to firms in the United States unless for special reasons the President decided otherwise. The Commission, however, found that the proposal of the German firm "was so much lower in price than any other, and the experience and reputation of this firm so excellent, that it was unquestionably the best of those received." In view of what has now happened it would be interesting to know if the Commission still hold the same views.

Concrete versus Earthworks for Fortifications.—The *Engineering Record of New York*, in a recent leading article, states that every war affords great scope for the skill of the engineer, and the present terrific struggle has already presented some questions of startling significance, reference being made to the gigantic tasks of transportation which are being performed. Not less in importance, however, are some other problems which demand immediate attention for efficiency and solution. One of these is to find the material of maximum effective resistance to high explosives. It seems to have been demonstrated effectively that concrete, which has been the main stand-by in modern fortifications, is almost useless in its customary form. The turrets of permanent concrete forts were rendered useless by a few rounds of shells charged with high explosives. From the photographs of the demolished works it appears that, even when the turrets themselves were not demolished, they were fairly blown off their foundation by the complete shattering of the concrete bases. On the other hand, temporary earthworks, and one or two forts heavily supported with earth, appear to have resisted attack by high explosives measurably well. A shell penetrating a few feet into concrete rends the whole mass, while in earth it merely opens a crater, which is partly filled in again by the falling dirt. It was noticed in the American Civil War that an active shovelling party could in a short time repair the damage of a heavy bombardment where an earthwork was concerned. The questions now to the front are whether any reinforcement of the concrete will be of service, or whether a proper choice of earth construction will so muffle the explosives as to make them comparatively ineffective. A few feet of loose dirt, or even of snow, will stop a bullet which would pierce a half-inch iron plate, and the same principle seems to hold good for heavy projectiles.

A Remarkable Wireless Station.—A powerful installation was recently opened by the Marconi Company for the Chilian Government at Punta Arenas, on the wild coast of Patagonia, in the Straits of Magellan, which is said to be the most southerly town in the world. The station is housed in a ferro-concrete building some three miles from the town, and contains a 100-kilowatt equipment for long-distance communication and a 5-kilowatt set for ship traffic, etc. Four distinct aerials are used, two for radiating different lengths of 100-kilowatt waves, one for the reception of long waves, and the fourth for the 5-kilowatt set. All are of the inverted L directive type, and are

supported on pulley blocks slung from porcelain insulators on 250-feet steel masts, so that an adjustable sag is allowed to prevent undue strain in heavy gales. Provision is made for passing current through the aerial wires to thaw them if covered with a dangerously heavy load of ice. The large generating plant is driven by a 270 horse-power Diesel engine, and develops 150 kilowatts at 200 to 360 volts continuous current. A 2,000 amperes-hour battery is also provided. The transmitting apparatus includes a condenser of 1·25 microfarads, made up of 416 Poldhu pattern pots of a new design charged at 10,000 volts, and a 36-inch radial disc discharger in a sound-proof chamber. Either 5,000 or 3,000 metre waves can be sent.

A Monster Locomotive Crane.—There is installed by the Browning Company of Cleveland, Ohio, at the New York Navy Yard, a locomotive crane which is the largest in the United States. Its main boom has a length of 85 feet and a capacity of 50 tons at the full radius. It handles big guns, armour-plate, boilers, and engines, which are used in the largest warships. A 38-foot extension boom is designed for the special purpose of handling the basket masts which are peculiar to the new Dreadnoughts. Formerly it was necessary to cut these masts in half, because there was no equipment of sufficient capacity to convey them as a unit. The new machine has ample stability for such work.

A Smart Piece of Military Engineering in Canada.—It is reported that Valcartier, Canadian Northern Railway Station, was recently transformed in less than two weeks into an important railway terminal with twenty miles of sidings. One of the items in the speedy construction work accomplished was the building of a pontoon bridge, to connect the main camp with the artillery practice-grounds belonging to the Royal Canadian Engineers. Work was begun on the bridge, which is 350 feet long, at eight o'clock in the morning and at ten minutes after noon the commanding officer was able to hurry a heavy gun across the completed structure. About 500 barrels were used in the construction of the bridge, which is of the pontoon type. The work was done by 300 men divided into squads, so that while one squad was making the barrels watertight another lashed them to heavy planks on which the superstructure rests, and still others carried the pontoons to the water's edge, floated them to position in the river or spiked down the superstructure. Simultaneously with the construction of the bridge a twenty-foot bank was graded down to afford an easy approach for the roadway. The builders were hampered by the large quantity of logs that were being carried down with the current, but no damage to the structure resulted. The work was carried out by the Royal Canadian Engineers, acting under the direction of Major W. B. Lindsay, of Winnipeg.

CORRESPONDENCE.

THE INDIAN INDIGO INDUSTRY.

In Sir Lewis Hay's letter to the *Journal* dated January 15th, he refers to the Japanese natural indigo industry in these words: "There is, or was up to a few years ago, a small indigo industry in Japan, but I do not know what method of extraction they employed."

As a matter of fact the industry still exists, though rapidly declining. The process employed for extracting the dye follows closely on the lines of the Chinese system, viz., by the use of lime in the steeping vats.

I have never heard of "replanting the steeped plants after extracting the dye," either in China or Japan, or even in the Loo Choo Islands, where probably the most primitive methods of indigo cultivation and dye extraction are employed.

In conclusion, I would refer anyone interested in the Japanese natural indigo industry to that very useful work "The Industries of Japan" (pages 173-176), by J. J. Rein (Hodder & Stoughton).

HENRY F. BRAY.

Tokyo Higher Commercial School,
Tokyo, Japan, February 20th, 1915.

THE HARDWOODS OF PANAMA.

The general article on the above subject in the *Journal* of February 26th gives some interesting facts; but I fear the writer has stated his case too loosely as to values, and unless expressed more clearly they can be of no guidance here, and are certainly misleading to the owners in Panama. As an instance, the article states that the lumber of "Guarea caoba" and "Carapa guianensis," is so similar to Honduras mahogany that it is equally valuable, about £18 per 1,000 ft. This does not indicate whether in log form, converted lumber, nor if the point of delivery is f.o.b. steamship or landed in England, or New York, or if the value is for standing lumber in the forest. To determine the value of proposal these are elementary points to know, and the nearness of lumber to a good river, so that it can readily be floated to seaboard, is an important factor when seeking a market. Your author gives the value of Panama hardwoods as over £98,000,000.

I will take the figure £18 per 1,000 ft. of the wood said to be equal to Honduras mahogany. If this is meant either standing in the forest or in log form, at the seaboard, the figures are misleading. I have before me offers of mahogany estates where the logs at seaboard would not cost one-third of this, so I will leave your readers to judge the value of trees in the forests; in fact, the expert opinion before me states \$2 per M feet as the value. Even if the author intended the values to be delivered at New York or London, they are too high; that

is overhead, the cost of logging, transportation to the seaboard, freight and landing charges, are serious items in this business, and faulty wood seldom makes freight and charges.

Wood has been intermittently shipped from Panama for many years, but unfortunately it arrives frequently seriously shaken, and is liable to be wormy, so that it has not commanded the universality of demand which is accorded to other shipments of mahogany.

There is certainly much in the article which needs explanation, especially if the author wishes to get the timber of Panama on to either the European or New York markets.

FRANK TIFFANY.

Leamington Spa, March 19th.

OBITUARY.

SIR JOHN CAMERON LAMB, C.B., C.M.G.—By the death of Sir John Lamb, which took place at his residence in Hampstead on March 30th, the Council has lost a highly valued member. Sir John joined the Society in 1892. In 1906 he was elected a member of the Council, in which capacity he served till 1909. During the year 1910–11 he was Chairman of the Council, and from that time till his death he continued a Vice-President of the Society. In 1910 he read a paper on "The Lifeboat and its Work," in which he worked out very carefully and exhaustively the question of the invention of the lifeboat. The Society of Arts in 1802 awarded a gold medal and a sum of fifty guineas to Henry Greathead, of South Shields, for its invention; but Sir John Lamb came to the conclusion, after very full research, that the rewards should have been given to Lionel Lukin, of Long Acre.

The subject of his Chairman's address, which opened the Session 1910–11, was the part played by the Royal Society of Arts in assisting the development of telegraphy. This was a question on which his official position at the Post Office entitled him to speak with authority, and he certainly made out a very good case for the Society. In addition to contributing these two papers to the Society's records, Sir John presided at several meetings and took part in discussions on various occasions.

Sir John Lamb was born in 1845. He entered the Post Office in 1864, became Assistant Secretary in 1889, third Secretary in 1896, and second Secretary in 1897, an office which he held till his retirement in 1905. He was chairman of many departmental and inter-departmental committees; he acted as British delegate to international conferences for the protection of submarine cables, which were held in Paris in 1886; he represented Britain and the Cape and Natal at the International Telegraph Conference held at Paris in 1890, and at Buda-Pest in 1896; and he presided over the Conference in London in 1903. He was the senior British delegate to the Conference on Wireless Telegraphy at Berlin in the same year; and he acted as chairman of the Government Committee to inquire into Injuries to Submarine Cables by Trawlers, which reported in 1908.

In addition to his other duties, Sir John Lamb took a very deep interest in the work of the Royal National Life-boat Institution, of which he was Vice-President and Deputy Chairman at the time of his death. He was also President of the British Consultative Council of the Hungarian Society.

In acknowledgment of his public services he was awarded the honour of C.B. in 1895, of C.M.G. in 1890, and he was knighted in 1905. He also received a number of foreign decorations.

GENERAL NOTES.

THE WILD CITRUS FRUITS OF MADAGASCAR.—Citrus fruits grow in a wild state in Madagascar, though in the centre and on the east coast of the island oranges and mandarins are grown in small quantities from planted trees. Oranges and lemons ("voasary" in Malagasy) of no fixed varieties are most common on the east coast, and are found either near the shore in sandy soil or more in the interior in compact soil, more or less flinty or rocky, and as a rule poor and arid. The trees do not grow in the shade of forests, but are scattered among bushes, usually next to guava and "voavontaka" (*Strychnos ipcnosa*) trees. The quality of the fruit, excepting the lemons, is generally poor. There is an orange tree (*Citrus aurantium*) on the west coast which contains little juice, and is attacked by a small larva which eats the pulp. The tree is also attacked by a larva or moth which devours the leaves completely. A small lemon ("voasary makirana" in Malagasy), about the size of a hen's egg, also grows on the north-west coast. On the east coast there are two local varieties of mandarins, and one imported variety from Zanzibar. Grape fruit or shaddock of an imported variety is found on the east coast. Semi-tropical fruits, such as mangoes, figs in small quantities, pomegranates, etc., also grow in Madagascar, but not in a cultivated state, except at the experiment stations at Tamatave and Nanisana.

NEW METHOD OF HATCHING SILKWORMS.—A new method of hatching silkworms is reported to have been perfected in Aichi Ken, Japan. The method is very simple. Egg cards are immersed in dilute hydrochloric acid for five to ten hours just before they are hatched. In a fortnight or twelve days after the immersion the eggs are perfectly hatched, and worms that are stronger and more healthy than those hatched in any other way may be seen coming out of the shells. The silk produced by the worms thus hatched is better and longer than that produced in any other way. It has been stated that the silk produced by the

worms bred in the newly-invented way measures 1,200 ft., whereas the thread produced by the worms hatched in the ordinary way measures only 700 ft. at the longest. It has been further stated by the inventor that anyone can make use of the new process, which, although declared by the American Consul at Yokohama to be worthy of being fully protected, will not be patented, as the inventor's sole desire is to strengthen Japan's position as a silk-producing country. The inventor is Mr. Kawahito, the Director of the Aichi Ken Sericulture Experimental Station.

The Internal-combustion Engine on the Oil Field.—In the course of a paper on this subject, read before the Institution of Petroleum Technologists by Mr. F. G. Rappoport, attention was drawn to the fact that the oil engine has created a large and important sphere of its own by facilitating profitable operation in certain wells which have a small yield. Each well had formerly to be closed, but the low fuel-consumption of the oil engine has rendered it possible to work them. The oil engine is admirably adapted for outlying districts and for prospecting work. In the Binagadi oil field, which has no adequate water supply, and in the new Ural and Biellik districts in Russia, it is very widely used. The only defects of the system as used at the present time are decentralisation and want of flexibility in transmission of the power.

The Tali-pot Palm.—A short account of the tali-pot palm (*Corypha umbraculifera*) is contained in the January number of the *Indian Forester*. The tree is indigenous in the Andaman Islands and Southern India, where it is put to many uses. The pith is used for flour, some thirty headloads being obtained from one tree. The leaves serve for umbrellas and thatching, and the seeds are converted into buttons. At Hanowar bats live under the shelter of the tali leaves, and when the lendi fruit (*Calophyllum inophyllum*) is ripe they bring back large quantities to their palm and drop the hard drupes. These contain oil, which is much valued, and the natives are, therefore, planting the tali-pot palm in order that they may obtain oil in this easy manner.

Canadian National Exhibition.—The Imperial Trade Correspondent at Toronto (Mr. F. W. Field) reports that the Canadian National Exhibition will be held in that city as usual this year during the last week in August and the first week in September. Mr. Field remarks that this Exhibition is considered to be one of the best annual exhibitions held on the American Continent, and there are indications that great interest will be taken in it this year despite the war and that a large number of manufacturing, machinery and miscellaneous exhibits will be made. Any British firms desiring space at the Exhibition should make early application to Dr. Orr, Secretary of the Canadian National Exhibition, City Hall, Toronto, from whom further particulars may be obtained.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock :—

April 14. — T. Thorne Baker, "The Industrial Uses of Radium."

April 21.—Moreton Frewen, "The State and the Fisherman."

April 28.—A. S. E. Ackermann, B.Sc., Assoc. M.Inst.C.E., "The Utilisation of Solar Energy."

May 5. — Augustus Vernon Harcourt, D.C.L., LL.D., D.Sc., F.R.S., "On the Measurement of the Efficiency of Domestic Fires, and on a Simple and Smokeless Grate."

May 12.—Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry." Sir Robert Abbott Hadfield, D.Sc., F.R.S., will preside.

Additional Lecture.

Thursday afternoon, at 4.30 o'clock :—

May 6.—M. Paul Lambotte, Directeur des Beaux-Arts au Ministère des Sciences et des Arts de Belgique, "Constantin Meunier et les Sculpteurs Belges de son Temps."

Indian Section.

Thursday afternoons :—

April 15, at 5 p.m. — Perceval Landon, "Basra and the Shatt-ul-Arab." The Right Hon. Earl Curzon of Kedleston, G.C.S.I., G.C.I.E., will preside.

May 13, at 4.30 p.m.—Sir Charles H. Armstrong, late Chairman, Bombay Chamber of Commerce, "Indian Trade and the War."

Colonial Section.

Tuesday afternoon, at 4.30 o'clock :—

May 4.—S. Chas. Phillips, M.S.C.I., "The Empire's Resources in Paper-making Materials." The Hon. Sir George H. Perley, K.C.M.G., Acting High Commissioner for Canada, will preside.

Date to be hereafter announced :—

C. H. Sherrill, "Ancient Stained Glass."

Cantor Lectures.

Monday evenings, at 8 o'clock :—

David Sommerville, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

Journal of the Royal Society of Arts.

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All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICE.

NEXT WEEK.

WEDNESDAY, APRIL 14th, 8 p.m. (Ordinary Meeting.) T. THORNE BAKER, "The Industrial Uses of Radium."

THURSDAY, APRIL 15th, 5 p.m. (Indian Section.) PERCEVAL LANDON, "Basra and the Shatt-ul-Arab." The RIGHT HON. EARL CURZON OF KEDLESTON, G.C.S.I., G.C.I.E., will preside.

Fellows are requested to note that this meeting will be held at 5 p.m., instead of the usual hour, 4.30.

Further particulars of the Society's meetings will be found at the end of this number.

PROCEEDINGS OF THE SOCIETY.

ALDRED LECTURE.

A meeting of the Society, under the terms of the Aldred Bequest, was held on Thursday, March 11th, 1915; LORD SANDERSON, G.C.B., K.C.M.G., in the chair.

THE CHAIRMAN, in opening the meeting, said that the late Dr. Aldred, a former member of the Society, left a bequest of £100 to be devoted to obtaining essays or lectures upon scientific and literary subjects. The money was invested, but it was only at occasional intervals, when the income had attained sufficient proportions, that the Society was able to use it, and on those occasions some subject had to be chosen for the lecture which it was thought was likely to be of general interest. It was a matter of common observation that people of ordinary education knew a good deal more about the distant events of history than they did of those which took place in the time of their grandfathers, and equally, in regard to Art, people knew a good deal about the artists and the pictures of the Renaissance down to the end of the seventeenth century, while of modern Art outside their own country they knew little or nothing. Circumstances of a painful character had recently drawn a great deal of attention to, and excited their interest in, Belgium, and those who, like himself, had gone to the recent Exhibition of the Royal Academy, would probably have been struck by finding how very little they knew of the modern schools of painting and sculpture which had grown up in Belgium since the time it had a separate existence in 1830. Everyone had some elementary knowledge of the old Flemish school; the names of Van Eyck, Mabuse, Memling, Rubens, Van Dyck, Snyders and Teniers were probably familiar to most people, but of the later painters they knew very little. The Society was fortunate in having been able to secure the assistance of M. Paul Lambotte, the eminent Director of Fine Arts in the Belgian Ministry of Science and Art, to illuminate their ignorance on the subject, and he would ask him to deliver his lecture.

The lecture delivered was—

L'ÉVOLUTION DE L'ÉCOLE BELGE DE PEINTURE (1830-1900).

Par M. PAUL LAMBOTTE,
Directeur des Beaux-Arts au Ministère des Sciences et des Arts de Belgique

Mesdames, Messieurs,—

Je me suis laissé dire que notre école belge du dix-neuvième siècle n'est qu'imparfaitement connue en Angleterre.

Et bien volontiers j'ai répondu à l'invitation si flatteuse de la Royal Society of Arts qui m'a demandé une causerie sur ce sujet.

Je ne puis vous parler, dans ce court espace d'une heure, du développement *de l'art* en Belgique pendant trois quarts de siècle. Il faudra bien laisser de côté aujourd'hui et la sculpture, dans laquelle cependant nos artistes ont excellé pendant la seconde moitié du dix-neuvième siècle, et l'architecture, qui a sa physionomie et son originalité chez nous, et la musique, qui prêterait à développement, et l'art décoratif, et bien d'autres choses encore.

En me bornant à vous entretenir de la peinture et des peintres, ou plutôt *de l'évolution de la peinture en Belgique*, j'aborde déjà un sujet beaucoup trop vaste et complexe. Je ne pourrai vous donner que des aperçus et des résumés.

Car nous avons eu et nous avons encore en Belgique un très grand nombre de peintres de beaucoup de talent et, à moins de vous réciter une sorte de catalogue, je n'aurai même pas le loisir de vous dire tous les noms marquants.

Je préfère tenter de vous expliquer quelles furent les tendances successives ou simultanées de notre peinture et vous montrer comment, dans un pays qui n'a pris conscience de sa personnalité qu'au moment où il a obtenu son indépendance avec un régime politique conforme à ses aspirations, les influences étrangères, tout à fait préponderantes d'abord, ont bientôt disparu sous la poussée d'une sorte de renaissance vraiment autochthone et locale, logique en somme, si l'on considère les traditions et les goûts de la race.

Cette étude m'amènera chemin faisant à vous entretenir des artistes qui ont apporté dans la peinture de notre pays quelque chose de personnel et de neuf, qui ont marqué comme chefs de groupes, ou comme individualités isolées, dont la personnalité a eu de l'influence sur le développement général de l'école.

Vous connaissez les œuvres de quelques-uns de nos peintres. Vous avez lu leurs noms, vous avez vu leurs œuvres. Un Leys, un Gallait, un Wiertz, un Alfred Stevens ne sont pas pour vous des inconnus.

Mais avez-vous songé qu'une école qui a produit ces maîtres doit compter *autour d'eux* un grand nombre d'artistes excellents ? Ces maîtres ne sont pas des exceptions, des étoiles isolées. Ils tiennent au milieu, au pays, à l'école.

Les circonstances ont fait que vous n'avez pas eu, en Angleterre, l'occasion de voir leurs œuvres et de les étudier. Il faut pour cette étude se rendre à Bruxelles, à Anvers, à Gand, à Liége, suivre dans les musées de ces villes le développement de la peinture en Belgique. J'ai parlé l'autre jour, non loin d'ici, d'Alfred Stevens, peintre de la Parisienne du second Empire. Mais j'ai pris la précaution d'éviter d'isoler le peintre de ses confrères. J'ai comparé notre école à une forêt touffue, compacte, pleine d'arbres de belle et saine venue. Alfred Stevens n'est que l'un d'eux. Beaucoup d'autres l'entourent.

Mais ces artistes, par suite de circonstances diverses, n'ont jamais participé aux expositions anglaises, ils ne sont représentés ni dans vos musées ni dans vos collections.

Tandis que le musée du Luxembourg à Paris ou le musée municipal de Venise sont riches en œuvres de l'école belge, les galeries britanniques n'en contiennent que peu ou pas. J'oublie les galeries d'Allemagne et d'Autriche qui en fourmillent. En ce moment, grâce à la munificence de M. Edmund Davis, qui a dépouillé sa maison au profit d'une entreprise charitable, vous pouvez admirer quelques belles pages d'Alfred Stevens à la French Gallery dans Pall Mall—et même vous pouvez constater que ses toiles ne sont nullement déplacées à coté des chefs-d'œuvre des diverses écoles et des diverses époques avec lesquels elles voisinent. Même elles vont et "tiennent" très bien avec deux merveilleux "Whistler," sur le même panneau ! C'est là un fait que je puis mettre en lumière avec un légitime et patriotique orgueil. Mais évidemment, je le répète, une école qui compte ce Stevens compte aussi beaucoup d'autres peintres non moins intéressants. Seules les circonstances ont fait que vous ne les connaissez pas.

La faute en est à l'indolence de nos artistes, qui ne tentèrent rien pour exposer à l'étranger. A part une exposition organisée au Guildhall, en 1900, par les soins du très distingué M. Temple, avec mon concours, je ne crois pas que les amateurs britanniques aient eu l'occasion de voir un ensemble d'œuvres belges du dix-neuvième siècle, un ensemble de pages maîtresses des peintres dont je vous dirai tout à l'heure, peu à peu et chemin faisant, les noms principaux.

Sans nul doute vous connaissez beaucoup mieux l'école hollandaise de la même période et vous pouvez vous étonner de cette différence entre des peintres contemporains les uns des autres et qui, à première vue, semblent devoir vous être aussi familiers les uns que les autres.

Israels, les frères Maris, Bosboom, Mesdag, Mauve, Bakkerkorf : voilà des noms qui représentent à vos yeux de beaux talents, de nobles œuvres, des peintures de prix aussi.

Mais vous ignorez Henri de Braekeleer, Alfred Verwée, Louis Artan, Joseph Stevens, Hippolyte Boulenger, Eugène Smits et bien d'autres qui, croyez moi sur parole en attendant de pouvoir vérifier cette assertion, valent bien les premiers et même valent souvent mieux que les premiers parce qu'ils n'ont pas travaillé pour le *commerce*. Pourquoi cette difference ?

Mon Dieu, mesdames et messieurs, c'est bien simple et nous n'y insisterons pas. C'est une question de marchands, tout simplement. Les artistes hollandais ont eu la chance d'avoir des marchands habiles qui ont su faire valoir leurs ouvrages, rendre leurs noms célèbres en dehors de leur patrie, leur maintenir ouvert le

marché français, le marché anglais, le marché américain.

Cela a manqué aux Belges, et les collectionneurs n'ont pas été assez avisés pour se passer de ces intermédiaires et acheter—oh, pas bien cher dans ces conditions—des œuvres qui, dans quelque vingt-cinq ans, seront extrêmement recherchées, vaudront leur pesant d'or.

Mais cela n'a aucun rapport avec leur qualité d'art et leur mérite. Ce n'est qu'une question de gros sous et de patience !

L'histoire de la Belgique, royaume indépendant, commence, vous ne l'ignorez pas, en 1830, au moment de notre séparation violente—de notre divorce de raison—d'avec la Hollande. L'histoire de la peinture en Belgique commence en même temps. On peut dire que depuis Rubens et le groupe de ses élèves au dix-septième siècle—sous le gouvernement prospère et suffisamment respectueux du principe des nationalités de l'archiduc Albert et de l'infante Isabelle l'art a subi une longue et trop totale éclipse. Après 1830 il refleurit.

Nous constatons tout d'abord la prédominance d'influences étrangères. Évidemment elles ne peuvent venir que de France, et c'est David - David le régicide, qui a résidé à Bruxelles en proscrit—qui les a introduites et répandues. Jean François Navez, un Belge, le meilleur élève de David, a subi complètement son ascendant et recueilli avec ferveur ses enseignements. Il devient le chef de notre école, le directeur de l'Académie de Bruxelles, le professeur des jeunes générations. Il a vécu longuement à Rome et à Paris ; il a admiré passionnément Raphael et Andrea del Sarto. Il revient tout féru de classicisme et ne rêve que " grand art," c'est à dire peinture religieuse et peinture d'histoire. Autour de lui tout un groupe se forme. On veut de grandes compositions, des scènes réunissant de très nombreux personnages de grandeur naturelle. Et ces scènes ne peuvent pas être empruntées à la vie quotidienne. On veut de la peinture à costumes, de la peinture à tirades qui fait penser aux drames romantiques, à Victor Hugo, à Dumas père. La jeune Belgique de 1830 a toute un pleïade de peintres qui fait du biblique, de l'historique, de l'allégorique.

J'ai nommé Navez ; il y a De Biefve, auteur du " Compromis des Nobles " ; il y a Decaisne, qui peint une " Belgique couronnant ses enfants illustres " ; il y a Nicaise De Keyzer, qui peint la bataille de Woeringen ou la bataille des Éperons d'Or ; il y a Slingeneyer, qui peint la bataille de Lépante : et cette spécialité met dans nos musées comme un rappel de la Galerie des batailles à Versailles. Elle nous donnera plus tard l'Abdication de Charles Quint, de Louis Gallait, et plus tard encore Pierre l'Ermite prêchant la croisade, de Gustave Van Aise, les peintures décoratives d'Alfred Cluysenaar et d'Émile Delperée.

Sans doute, mesdames et messieurs, je sais bien que cet art est démodé, que ce n'est pas beaucoup de la peinture, que cela manque de tout ce que les vrais peintres ont introduit de plasticité, de sensibilité, d'impressionisme dans l'art. C'est froid, c'est figé.

Mais il faut bien reconnaître d'autre part que ces " vastes machines " résument une belle éducation technique. C'est composé, c'est dessiné, c'est exécuté. Quand on voit l'impuissance où se débattent maintenant tant de peintres quand il s'agit d'agencer un groupe ou de construire même une figure, on ne peut se tenir de rendre justice aux grands ancêtres qui *savaient* si bien tout ce qu'il faut savoir, sauf à mal utiliser ce savoir.

Seulement ces peintres, qui étaient peintres de figures, ont peint, par délassement ou gagne-pain, beaucoup de portraits. Et dans ces portraits ils sont évidemment très forts ; observateurs de la nature avec une simple et saine conscience, ils ne cherchent pas à en faire accroire et paient comptant, sans escamotages.

Le vieux Navez, comme son maître David, nous a laissé des portraits magnifiques. Nous ne regardons plus ses tableaux religieux ou ses anecdotes historiques, mais nous commençons à rechercher et à collectionner ses portraits. Il y a des groupes, parfois six ou huit personnes de grandeur naturelle réunies sur la même toile, qui sont remarquables.

Voici la " Famille de Hemptinne " ; elle est au Musée de Bruxelles. En outre de ses mérites d'agencement et de style, dont vous pouvez juger malgré l'imperfection de cette reproduction, cette toile a des qualités de couleur à la fois fortes et rares qui ne peuvent passer inaperçues.

Je dois demander l'indulgence pour la serie d'illustrations qui éclairera ma causerie ce soir. Par suite des circonstances douloureuses que nous traversons, je n'ai rien pu faire venir de Belgique ; il a fallu se contenter de reproduire des images prises dans des livres. Il y a beaucoup de lacunes. Je vous montrerai une série très incomplète de projections qui ne donnent qu'une idée très faible et parfois désastreuse des œuvres qu'elles devraient représenter. Mais vous m'excuserez et votre imagination suppléera ce qui manque.

Ce portrait de Hemptinne est déjà un premier gage d'un retour à l'observation de la nature, à la sincérité, à la simplicité, par réaction contre les conventions de l'académisme de David. C'est le commencement des conquêtes du sens réaliste inhérent à la race, rejetant les influences étrangères qu'il n'a pu s'assimiler.

D'ailleurs l'apparition même des grandes compositions dont je vous citais, il y a un instant, les principales, a suscité très vite d'autres réactions, a provoqué des querelles fécondes.

Le Baron Wappers a pris la tête de ce mouvement de retour à l'observation de la nature. Voulant peindre lui aussi une grande composition d'histoire, il a choisi cet "Épisode de la Révolution," et montré des contemporains en costumes contemporains. On a beaucoup discuté, ergoté, épilogué. Chaque tendance a gardé ses partisans, toutes deux ont coexisté longuement et toutes deux finalement ont disparu par un autre retour de la mode pour faire place à d'autres recherches.

Je veux vous dire quelques mots d'un homme qui a occupé, et occupe encore, une place isolée dans l'école, un homme en qui le Gouvernement Belge et le grand ministre Rogier ont cru profondément, un homme qui est consacré à Bruxelles par un musée de ses œuvres que tous les étrangers vont voir.

Wiertz, Dinantais un peu hâbleur, a fini par se persuader qu'il avait retrouvé les pinceaux de Rubens, et que dans la suite ininterrompue des artistes se passant symboliquement le flambeau de main en main il avait reçu du Maître directement le précieux don !

Wiertz est un philosophe grandiloquent, un chercheur curieux, mais il n'a, en fait, aucun instinct de la plasticité. Son dessin est emphatique ; il n'a ni style ni rythme ; sa couleur a des rapports faux ; il n'a pas le sens de l'harmonie.

Je concède volontiers que ses grandes compositions, "Les Grecs et les Troyens se disputant le corps de Patrocle" ou le "Christ et l'Humanité," offrent un certain intérêt, mais cela est tout ce que vous voudrez—excepté de la peinture ! Et quand Wiertz veut peindre "un morceau," un portrait par exemple, d'après nature, on sent à la fois son impuissance et son dédain orgueilleux.

Je vous parlais il y a un instant des beaux portraits de Navez et de ses contemporains.

Il est un peintre de cette époque dont je me plais à évoquer un instant la figure déjà devenue mystérieuse et lointaine. François Simoneau, tel est son nom, est représenté au Musée de Bruxelles par deux œuvres de grande valeur, et nous connaissons un portrait de lui chez la fille du peintre de marines Clays. Nous savons que Simoneau fut formé à l'Académie de Bruges, qu'il a travaillé à Paris avec le Baron Gros, et qu'après un court séjour à Bruxelles il s'est fixé à Londres où il a achevé une carrière qui paraît n'avoir point été heureuse. Il y est mort en 1859. On retrouve trace de l'apparition de ses portraits aux salons de la Royal Academy et à des expositions diverses. Mais à chaque nouvelle apparition le peintre réside à une adresse nouvelle. Il descend vers les quartiers humbles, il est visiblement un homme qui ne réussit pas, que la gêne d'abord, la misère ensuite ont étreint. J'ai vainement cherché à retrouver en Angleterre des portraits de François Simoneau, et M. Marion H. Spielmann, votre érudit critique d'art, a bien voulu tenter de m'y aider sans y avoir réussi plus que moi, malgré sa bonne grâce obligeante. Les trois peintures jusqu'à présent uniques—conservées à Bruxelles, aiguisent mon désir d'en voir d'autres. Elles semblent apparentées aux œuvres de Sir Joshua Reynolds ou de Sir Thomas Lawrence. Je me demande si déjà les meilleures de celles qui furent peintes en Angleterre n'ont pas changé d'état civil et augmenté le catalogue des œuvres d'autres peintres britanniques "qui se vendent bien" ? Je serais reconnaissant à tous ceux qui connaîtraient ici des peintures de François Simoneau de me les indiquer.

Nous n'avons pas eu seulement en Belgique des peintres d'histoire qui peignirent—accessoirement—des portraits. Nous avons eu aussi des portraitistes exclusivement adonnés à cette spécialité.

Le plus éminent fut Liévin De Winne, qui fut essentiellement l'historiographe d'une société intellectuelle et un peu puritaine. C'est un peintre de la vie intérieure, sachant ne jamais se parer des prestiges d'une technique cependant très savante et très expérimentée. Je dirai que Liévin De Winne fut le peintre des grands bourgeois, hommes politiques, hommes de science, professeurs, magistrats. Beaucoup de ses portraits sont psychologiques, profondément, et bien avant le trop fameux Lenbach, avec une sincerité toute simple, De Winne a sacrifié à l'expression des visages tout le pittoresque un peu facile des arrangements de costumes et de décors. Les portraits de Liévin De Winne sont graves, ressentis ; ils n'attirent pas les regards, mais ils les retiennent intensément dès qu'ils les ont fixés. Les fonds sont neutres,

les vêtements noirs et discrets, et même dans les portraits de femmes il n'y a pas de concessions à l'effet, à la mode. Non, seuls les visages, traités avec un art qui ne s'affiche pas, respirent, pensent, avèrent des individualités originales.

Nos musées belges ont commencé de recueillir des portraits de L. De Winne. Quand les familles des modèles s'éteignent ou se dispersent le moment des musées arrive. Nous avons fait cela à Bruxelles pour Navez et pour De Winne. À Gand, ville natale de l'artiste, toute une série de ses œuvres a été groupée déjà au musée

Il est un peintre qui a conquis dans notre école une place prééminente et dont l'influence a été considérable, même hors de Belgique. J'ai nommé le Baron Henri Leys, qui fut l'initiateur de tout un mouvement d'art. Il a formé des disciples éminents. Directeur de l'Académie d'Anvers, il fut le maître d'Henri de Braekeleer et de nombreux peintres belges remarquables. Il fut aussi, et la gloire n'est pas mince, le maître d'Alma Tadema, ce Hollandais qui devait devenir un grand Anglais, et de James Tissot, Américain, je crois, que la France a adopté.

Leys a rompu avec la tradition des peintres d'histoire qui se recommandaient, à la suite de Navez, de la Renaissance italienne. Avec une prescience curieuse il est remonté aux influences des maîtres primitifs de la Flandre et de l'Allemagne. Il s'apparente, sans pastiche, à Holbein et à Cranach. Il ne les imite pas, il ne les continue pas, il peint comme s'il était l'un de leurs contemporains, avec un sens du passé qui confond l'entendement.

Leys paraît retrouver la vision d'autrefois comme si la mémoire d'une existence antérieure ranimait les scènes abolies sous ses yeux. Les personnages qu'il met en œuvre ne sont pas des modèles costumés plus ou moins à l'aise dans des oripeaux de hasard. Ils ne posent pas. Ils vivent leur vie, à l'aise, sans anachronisme, dans le décor authentique, le milieu exact de leur temps. Les habits vont aux corps, aux habitudes de l'être, tout est plausible, harmonieux. Leys est un évocateur qui paraît retrouver dans les profondeurs d'un passé lointain des visions fidèles et complètes. Avec cela il est peintre de race, coloriste à la manière des vieux maîtres du pays, somptueux et brillant.

En outre d'une nombreuse série de tableaux de chevalet, Leys a laissé deux ensembles de compositions monumentales qui assurent la pérennité de sa gloire: les panneaux de la grande salle de l'hôtel de ville d'Anvers et ceux qu'il avait peint pour la décoration de sa propre salle à manger et qui, après son décès, ont été transportés eux aussi à l'hôtel de ville d'Anvers. On a détaché très habilement les fresques des murs et on les a disposées, conformément aux conceptions de Leys, dans une salle de dimensions analogues. Leys avait peint à l'huile des répliques de tous ces panneaux. Les Musées de Bruxelles et d'Anvers et divers collectionneurs se glorifient de les posséder. L'un d'eux, acheté par le sénateur américain Vanderbilt, est encore en exil quelque part à New-York.

Toute une école a suivi les enseignements de Leys, mais dépourvus de son curieux instinct d'archaisme ses imitateurs ont été en affaiblissant l'effet de ses découvertes.

Cependant la grande salle échevinale de Bruges, décorée par Albert de Vriendt, l'escalier de l'hôtel de ville d'Anvers, orné de panneaux peints par divers élèves de Leys, la salle des mariages à l'hôtel de ville d'Hoogstraeten et quelques autres ensembles ne sont point négligeables.

Dans un autre esprit et, je dirai, une autre formule, et pour achever la revue des grandes compositions monumentales, je dois citer encore les peintures de la Halle aux draps à Ypres, que les obus incendiaires des armées de Guillaume II. ont si lamentablement et inutilement détruite Pauwels avait peint sur ces murs des compositions intéressantes, mais un autre artiste, Louis Delbeke, y avait consacré toute sa vie et tout son art. L'ensemble de cette décoration évoquait une belle et originale figure d'artiste.

Ces peintures n'étaient pas très connues, Ypres étant éloigné des centres et mal desservi par le chemin de fer. Sans doute on y allait en automobile, mais combien d'excursionnistes ont su apprécier cet art singulier et savoureux auquel tous les artistes rendaient hommage ?

L'autre jour encore votre grand maître décorateur, Frank Brangwyn, me parlait avec admiration de l'œuvre de Delbeke, et ensemble nous avons deploré avec une tristesse profonde, la disparition définitive, irrémédiable, de tout ce qui devait assurer à cet homme, mal apprécié et connu, les revanches de la célébrité future. Hélas . . . la pauvre Flandre, la pauvre Belgique, meurtries, écrasées, brutalisées, ont perdu bien d'autres trésors d'art, c'est leur destin historique d'être sacrifiées et depouillées, mais de se relever toujours ensuite et de créer de nouvelle beauté !

Louis Gallait a occupé une place très importante dans notre école. Il fut en quelque sorte le peintre officiel de la Belgique et son ambassadeur

artistique à l'étranger. Son "Abdication de Charles Quint" et, surtout, "Les Derniers Honneurs rendus aux Comtes d'Egmont et de Horne" (les têtes coupées) lui ont valu une notoriété européenne. Il est représenté dans beaucoup de musées et c'est à lui que le gouvernement a commandé des panneaux décoratifs pour la salle du Sénat, les portraits du Roi Leopold II. et de la Reine Marie Henriette et bien d'autres choses.

Charles Hermans est l'auteur d'un tableau célèbre intitulé "A l'Aube," qui, en outre de ses rares mérites de peinture, offre un intérêt quelque peu social. Hermans, qui vit encore, et n'a jamais cessé de travailler dans la méditation et l'isolement, laissera un œuvre très important et curieux, encore mal connu et apprécié.

Alfred Cluysenaar a décoré de grandes pages d'histoire violentes et hautes en couleurs le grand escalier de l'Université de Gand.

Emile Delperée a peint à Liège des compositions illustrant l'histoire locale. J'ai la bonne fortune, grâce à l'obligeance de M. Clifford Smith, de pouvoir vous montrer une esquisse excellente de Delperée, qui résume les qualités de ses œuvres définitives.

André Hennebicq est l'auteur d'autres panneaux placés dans les hôtels de ville de Louvain et de Tournai.

Enfin un homme qui s'est acquis en Belgique une situation prépondérante, et qui maintenant vit à Paris, Émile Wauters, est l'auteur de grands tableaux d'histoire qui ont renouvelé le genre en y introduisant, avec un souci curieux de la réalité et de la simplicité, des éléments de pittoresque et une saveur d'exécution très personelle. Il faut voir au Musée de Bruxelles et dans l'escalier d'honneur de notre hôtel de ville, ces compositions qui s'éloignent autant de Navez ou de Gallait que de Leys, et qui respirent un ardent amour de la vie.

Alfred Cluysenaar, Delperée, Hennebicq, Jean de la Hoese, Jean G. Rosier et Wauters principalement ont peint un grand nombre de portraits. Ils nous ont dotés d'un panthéon de célébrités non seulement locales mais cosmopolites.

L'hôtel de ville de Bruxelles, la salle des séances du Sénat de Belgique, les Musées de Bruxelles et de Gand montrent des décorations importantes et très originales exécutées par le Comte Jacques de Lalaing, peintre et sculpteur à la fertilité prestigieuse, à l'invention intarissable.

Léon Frédéric, plus spécialisé dans les tableaux de chevalet, a peint pour la salle de milice de l'hôtel de ville de Bruxelles un important panneau, "Le Départ des Conscrits," montrant la jeunesse d'un village partant pour la caserne au moment des moissons. C'est une page d'une profonde humanité, rustique, familière, éternelle.

En suivant le développement d'une lignée de peintres adonnés à la même spécialité, j'ai descendu le cours des années sans tenir compte de contemporains auxquels il faut que je revienne. Je viens de vous parler des peintres encore vivants, et même jeunes, relativement, quoique notoires. Je remonte vers le passé pour rejoindre d'autres peintres de figures—Alfred Stevens, Charles de Groux, Henri de Braekeleer, Eugène Smits, qui furent des hommes de premier plan, je veux dire des hommes qui seraient au premier plan dans toutes les écoles d'Europe et qu'une notoriété universelle consacre déjà; et puis Madou, Florent Willems, Portaels, Édouard Agneessens, qui ont leur importance chez nous et qu'on ne peut omettre.

Alfred Stevens est le plus connu, le plus étudié. Il fit à Paris la majeure partie de sa carrière et, comme je le disais il y a un instant, les grands collections d'Europe et d'Amérique, tous les musées, ceux de Bruxelles et d'Anvers principalement, mais aussi le Luxembourg à Paris, et la Pinacothèque de Munich, et la galerie de Buda-Pest, et le Musée de Marseille et celui de Liége, et le Metropolitan de New-York et bien d'autres montrent en bonne place ses pages d'exécution parfaite, dignes des plus appréciés d'entre les petits maîtres hollandais. Je vous remémore vite, sur l'écran, quelques-unes de ces pages charmantes et fortes.

Charles de Groux est moins connu hors de Belgique. C'est un peintre ému de la vie des humbles, un réaliste qui toujours cependant fait preuve d'un sens pathétique de la poésie élémentaire de la nature. Ses tableaux ne sont pas déclamatoires, ils ne prêchent pas, ils persuadent la grande pitié pour les pauvres, les souffrants.

De Groux a débuté comme peintre d'histoire. Lui aussi a exposé d'abord de grandes pages, une "Mort de Charles-Quint," un "Prêche dans une cave sous la réforme," que nos musées abritent. Mais il est devenu lui-même plus tard, quand il nous a révélé, avec un dessin parfois un peu gauche, mais un sens si exquis de la beauté de la vie et de la couleur, les scènes simplement poignantes dont il s'est fait une spécialité.

Voici "Le Bénédicité," d'une tranquillité si imposante, et cette "Scène de Cabaret," si touchante dans sa réalité pitoyable.

Charles de Groux fut l'ami et le maître de

notre grand Constantin Meunier. C'est près de lui que Meunier a trouvé au début un confident pour ses rêves, des encouragements pour ses essais. Simple et pathétique dans l'extériorisation de ses conceptions, Meunier a longtemps recherché des modes d'expression adéquats. Il a tenté toutes les expériences, éprouvé tous les procédés. C'est, en somme, le grand statuaire que l'humanité d'aujourd'hui a compris et aimé, mais nous avons en Belgique les traces des deux carrières successives du maître, celle du peintre, qui fut discutée, celle du sculpteur, qui ne parvint à la notoriété qu'après la soixantaine sonnée et pour si peu d'années de sérénité enfin acquise après les traverses d'une vie qui fut un Calvaire.

Henri de Braekeleer est un peintre d'Anvers qui fut le neveu et l'élève favori de Leys. Son œuvre n'est guère connu hors de Belgique. Il n'a pas laissé un très grand nombre de peintures parce que chacune fut longuement réalisée par un travail appliqué et patient.

Encore une fois il faut venir aux Musées de Bruxelles et d'Anvers étudier cet intimiste qui sut réaliser des harmonies si imprévues et si rares et exprimer par le plus simple décor, par des figures populaires et banales, une conception de la vie si tranquille, si enfermée dans un petit cycle moral. C'est un matérialiste ému par la couleur, les harmonies sourdes et somptueuses de la lumière sur les choses, un homme tout à fait isolé et à part dans toutes les écoles.

Voici de ses œuvres, mais combien affaiblies et incompréhensibles dans ce résumé photographique. C'est la polyphonie de Wagner réduite pour le piano, ou moins encore. J'ai trouvé au Musée de South Kensington, parmi les œuvres intéressantes léguées par M. Ionides, un petit paysage d'Henri de Braekeleer qui pourrait donner envie de voir des choses plus importantes et plus caractéristiques de ce peintre.

Eugène Smits, peintre de Bruxelles, mort il y a deux ans seulement, n'est pas connu encore selon ses mérites. Sa peinture est celle d'un être exquis, d'un être sensible à toutes les élégances morales, à toutes les influences de la beauté. Nous avons au Musée de Bruxelles son prestigieux "Cortège des Saisons" :—

"Cortège harmonieusement rythmé dans lequel la jeunesse fleurie du printemps, enveloppée de voiles roses, salue gracieusement la paleur triomphale de l'été qui s'avance calme sous l'or de son chapeau de paille, devant la sérénité bleue d'un ciel splendide. L'automne apporte ensuite la sumptuosité de ses rouges cuivrés, sonores comme des fanfares. Et l'hiver paraît enfin, dans des draperies de deuil. Mais sa vieillesse n'est pas isolée, car un être jeune (symbole des recommencements de la nature) l'accompagne doucement de son dévouement discret" (Fernand Khnopff).

Voici "Roma," une toile célèbre de la jeunesse de Smits, composition exécutée à Rome, actuellement en possession de Sa Majesté le Roi des Belges.

"Le Bonheur et le Malheur," d'après le poème de H. Heine. Le bonheur est une jeune fille qui passe un instant et s'enfuit en vous envoyant un baiser ; le malheur est une vieille femme qui s'installe à votre chevet et prend son tricot.

"Perdita," un petit bijou de raffinement coloriste, "une délicieuse figure féminine sur un petit panneau où l'on voit des blonds carminés, délicieux comme une soyeuse relique vénitienne, et des noirs aux profondeurs dorées, tels qu'en offrent les plus riches laques du Japon."

En voila assez pour vous donner l'envie de connaître l'œuvre d'Eugène Smits, ce Smits exquis qui fut l'intime ami de Ricard, de Jongkind, de notre grand sculpteur Paul de Vigne, d'Octave Pirmez, un pensif homme de lettres dont notre littérature s'honore.

J'insiste un peu sur cette personnalité d'exception d'abord parce que je l'aime, et c'est une excuse peut-être suffisante, et aussi parce qu'elle est encore inconnue à l'étranger et que je me sens en quelque sorte le précurseur de sa prochaine et inévitable gloire en lui rendant hommage avant que ce soit une opinion banale, consacrée par cette admiration toute faite qui ne voit plus, ne discute plus, demeure convaincue sur le dire de gens autorisés.

Vous n'avez pas pu constater ce que ces œuvres doivent au charme de leur couleur rare et personnelle, montrent de mesure et d'équilibre. La grâce des formes, l'eurythmie des attitudes, leur confèrent un attrait séducteur.

Comme l'a finement discerné Camille Lemonnier, "la peinture d'Eugène Smits éveille un goût de volupté langoureuse et noble. Il suggère le songe, la méditation, le désir, les regrets et l'amour . . . C'est le rêve de la vie qu'elle exprime dans des harmonies douces et ardentes comme des cuivres lointains. Les œuvres de Smits tiennent d'une sorte d'état d'âme silencieux et nostalgique."

Cela est justement pensé.

Si nous considérons quelqu'une de ces belles œuvres de Smits qui "par un côté touchent au

rêve,"* un profil de femme rousse, un coin de paysage sous un ciel bleu, une épaule nacrée au bord d'un corsage rose, la gaze noire d'une écharpe sur la pâleur d'un front, nous retrouvons dans notre propre passé, avec quelle émotion attendrie, un parfum qui fleure notre jeunesse, nos beaux espoirs que la vie devait decevoir, des apparitions fugitives qui firent battre notre cœur dans la sérénité ancienne des soirs d'été, des paysages entrevus au cours des prestigieux voyages, et, d'un mot, tous les mirages du passé aboli dont la mélancolie du présent est faite.

Je vous parlerai très brièvement de Madou, peintre de genre spirituel, un peu bourgeois, qui a laissé des ouvrages très fins dans lesquels se retrouve la verve d'un Teniers ou d'un Ostade; de Florent Willems, qui pasticha—un peu trop à mon gré—Terborgh ou Metsu, mais que la vogue a adopté longtemps; Jean Portaels, parce qu'il fut principalement un éducateur, un chef d'atelier, le continuateur de la tradition de Navez et de son maître David. Un grand nombre des hommes marquants de notre école doit quelque chose aux enseignements de Jean Portaels. C'était un professeur respectueux du tempérament et des dispositions de ses disciples. Il n'a pas coulé dans un moule unique leur inspiration et leur technique. Des peintres et des sculpteurs extrêmement différents entre eux se formèrent sous sa direction clairvoyante.

L'un des plus curieux fut Édouard Agneessens, qui mourut jeune et n'a pas laissé beaucoup d'œuvres. Ce fut un peintre sans grande imagination; il n'a guère traité que des figures isolées ou des portraits. Mais chacun de ses tableaux est un morceau de peinture d'une rare et personnelle saveur et qui durera.

Malgré mon désir d'éviter les énumérations et les notices et de m'en tenir à des aperçus généraux, il est difficile d'omettre les noms et les œuvres des hommes qui ont apporté une vision à eux et renouvelé des aspects de notre peinture.

Les images que vous venez de voir et les commentaires que vous avez écoutés vous ont fait apercevoir, je pense, quelque chose de l'évolution de la peinture pendant un demi-siècle chez nous, depuis le classicisme du début jusqu'au naturalisme discret des plus jeunes.

Le tempérament national a réagi contre les influences du dehors, il se les est assimilées en les adaptant à sa nature, en les transformant, en les rendant méconnaissables, ou bien il les a éliminées. Sans doute dans un pays au territoire exigu situé comme le nôtre au confluent de races et de civilisations diverses ces influences du dehors ont toujours été perceptibles. Nos artistes sont toujours attentifs à ce qui se fait à l'étranger, en France principalement. Il n'est par douteux que Courbet d'abord, Jean François Millet et plus tard les impressionistes n'aient leur reflet dans certaines œuvres belges d'une certaine époque. Courbet de son côté à été pénétré d'influences belges. Il a beaucoup travaillé chez nous. Le succès de Manet a eu son contre-coup dans nos ateliers. On s'est mis alors à étudier Velasquez!

Tout cela, qui est perceptible dans les tableaux à figures et les portraits que vous venez de voir, ne l'est pas moins dans le paysage ou la nature-morte.

Notre école de paysage d'après 1830 débute par des "compositions" artificielles, péniblement élaborées. Elle arrive assez vite à l'observation pure et simple de la nature, à la simplicité. Notre petit pays offre des aspects charmants et très variés. C'est comme un raccourci, un résumé des aspects de diverses contrées. La plaine stérile de la Campine avec ses marais, ses bruyères, ses sables, ses sapinières est bien différente de la plaine des Flandres fertile et grasse. Le Brabant ondulé, le Hainaut hérissé de charbonnages, de hauts fourneaux, d'usines et de manufactures, montrent des paysages très caractéristiques.

Dans nos Ardennes c'est la colline, les fagnes, les hauts plateaux, en Condroz les vallons rocheux, les sentiers creux entre les haies fleuries. Le cours de la Meuse, sinueux, parfois encaissé, reflétant les forêts, les villages de ses rives, diffère complètement du cours de l'Escaut, large, étalé, blond. Nos villes anciennes et pittoresques, nos villages aux types si différents entre eux, comme les sites agrestes ont trouvé leurs interprètes. Et la côte maritime, les plaines liquides de la mer du Nord ont inspiré nos peintres.

Chacun mit au service de ses interprétations ses dons personnels et ses croyances, ses recherches et son acquis. Cela forme une pléiade compacte d'artistes qu'il est bien difficile de grouper et de caractériser.

Fourmois est l'un des plus anciens. On goûte son talent de dessinateur, son sens d'observateur et la solidité de sa touche, en même temps que son coloris sobre et puissant.

Alfred de Khnijff aima des sites plus simplifiés, des paysages plus amples et moins encombrés. Il les traita avec une discrète maîtrise.

* Eugène Smits, "Écrits sur l'art."

Hippolyte Boulenger fut l'un des plus significatifs parmi nos paysagistes. Il rejeta les traditions académiques et le souci des compositions élaborées pour se consacrer ingénuement à l'école du plein air. Il a laissé des pages amples et fortes, très hardies pour leur temps, avec des orages, des arcs en ciel, des coups de vent, un souci d'observation météorologique très prime-sautier et très prenant.

Autour de lui se groupèrent les paysages de l'école dite de Tervueren, assez nombreux, dont je ne puis à peine vous citer les noms, Theodore Baron, Joseph Coosemans, Jean Degreef. Boulenger peut-être doit-il quelque chose à Constable, votre grand maître anglais, qui, formé lui-même d'ailleurs par notre bon paysagiste flamand Siberecht, est très compris et admiré chez nous.

Louis Dubois fut un de nos beaux peintres du dix-neuvième siècle, considérable surtout par des dons de coloriste et d'exécutant. Il a touché tous les genres et excellé surtout dans ceux qui exigeaient précisément le judicieux emploi de ses facultés un peu restreintes, la nature-morte, le paysage. On ne peut le passer sous silence.

Nous avons eu deux marinistes tout à fait éminents : Louis Artan, qui fut le peintre ému de la Mer du Nord, coloriste délicieux, capable de rendre tout le fugace et tout le mouvant de la vague et du nuage; et Jean Pierre Clays, qui peignit plutôt les bateaux que la mer, et trouva ses meilleures inspirations par de calmes journées, à l'estuaire de l'Escaut, parmi les chalands vernis sortis des canaux et déployant leurs voiles goudronnées.

Alfred Verwée est, à mon sens, un homme de tout premier plan parmi les peintres du dix-neuvième siècle. Il a étoffé de grands animaux les larges paysages de la Flandre, sous leurs cieux mouvementés. Sa couleur est une merveille de fraîcheur, de charme et d'harmonie. On lui a reproché parfois le dessin imprévu de ses chevaux ou de ses vaches. Mais depuis que les instantanés photographiques ont permis de décomposer les mouvements successifs des bêtes en marche, on a dû reconnaître que Verwée avait su apercevoir, discerner et rendre avec une merveilleuse précision des attitudes, fugitives sans doute, mais parfaitement justes. Un beau paysage de Verwée animé de bétail s'étend sous un ciel que la brise anime, il flatte les yeux par l'émail précieux la qualité incomparable de ses pâtes, il rafraîchit et réconforte comme l'air même de la terre natale.

La personnalité d'Alfred Verwée m'amène a vous présenter les peintres spécialistes de la peinture d'animaux : Verboeckhoven, Verlat, qui ne nous retiendront pas ; Joseph Stevens, qui a peint des chiens avec une incomparable maîtrise et composé des tableaux égaux aux plus appréciés d'entre ceux des meilleurs maîtres hollandais ou flamands du dix-septième siècle. Son frère Alfred lui écrivait un jour : "Moi je suis de mon temps, mais toi, Joseph, avec Fyt, Snyders et Jordaens, tu es de ta *race*. Ainsi tu es de tous les temps."

On ne saurait mieux dire, et c'est un jugement que la postérité ratifiera.

Jean Stobbaerts fut aussi un animalier de marque. Il a consacré ses pinceaux aux intérieurs d'étables, aux recoins vétustes des fermes et des logis populaires où les bêtes vivent pêle-mêle avec les gens.

C'est aussi un virtuose de la pâte, un remarquable exécutant qui sut faire de la robe tachetée d'une vache, de la croupe baie d'une jument ou des peaux rosées des petits cochons, des prodiges de peinture.

Une femme, Madame Henriette Ronner, hollandaise il est vrai d'origine, mais belge de cœur, et dont toute la carrière s'est déroulée à Bruxelles, fut l'interprète avertie et agile des chats, dont elle a peint les jeux ou les repos du bout d'une brosse désinvolte, avec de charmantes recherches de colorations.

Ce sont ces recherches de colorations, en même temps que la beauté du "morceau" d'exécution, qui fait tout le charme des "natures-mortes" et des tableaux de fleurs. La disposition native de nos artistes pour les harmonies de couleurs toujours renouvelés leur a permis d'exceller dans ces genres. Presque tous en ont essayé. Les "intérieurs" d'Henri de Braekeleer sont souvent des "natures-mortes." Alfred Verhaeren a continué de creuser ce sillon avec une brillante et savoureuse virtuosité. Mlle Alice Ronner, de son côté, y réussit à merveille, avec des dons très différents.

En parlant de ces artistes qui sont maintenant en pleine production je sors peut-être un peu des limites de mon sujet ét j'aborde un terrain glissant et dangereux.

Mais puisque ces peintres étaient déjà notoires, représentés dans les musées et les collections avant 1900 je continue à m'aventurer parmi eux.

Notre école de paysage comptait en ce moment un grand nombre d'artistes très personnels.

Je citerai d'une part Adrien Joseph Heymans, et Émile Claus, d'autre part Franz Courtens, et je mettrai à part Albert Baertsoen.

Heymans et Claus, avec des dons très différents et dans des pays qui ne se ressemblent pas. l'un en Campine, l'autre en Flandre, sont des peintres de la lumière, de la vibration lumineuse. Ils sont arrivés tous les deux à la plus exacte notation des couleurs sous le rayonnement diurne ou nocturne, et par leur sincérité et leur amour de la nature ils ont atteint une poésie très éloquente.

Courtens, au contraire, a aimé les matérialités, la substance des choses. Il a peint des paysages opulents et lourds, d'une indéniable puissance. Victor Gilsoul peut lui être apparenté en quelque façon.

Albert Baertsoen fut le premier à apercevoir la beauté de certains sites de nos vieilles villes endormies. Il a su se garder des *jolis coins*, trop jolis, qui séduisent le touriste superficiel, la demoiselle aquarelliste amateur, et le photographe pour cartes postales !

Il a planté son chevalet devant des choses que personne n'avait regardées encore, et il en a fait sentir tout le charme intense et recueilli.

Voici un tableau qui appartient au musée d'Anvers. Je regrette que vous ne puissiez apercevoir la modulation infiniment subtile des valeurs, la rareté distinguée de l'harmonie, tout ce qu'un œil de peintre fervent et fin a découvert dans cette petite place sans architecture.

Baertsoen a fait école. Je citerai près de lui Opsomer, Viérin, et je tairai beaucoup de noms afin de n'être pas fastidieux.

Le temps s'écoule, et je suis effrayé du nombre de personnalités très curieuses que compte en ce moment notre école et dont je n'ai rien dit ou trop peu parlé encore.

Xavier Mellery, peintre de la vie des choses et créateur de symboles plastiques, mériterait une étude.

Fernand Khnopff, maître de toutes les recherches, de tous les raffinements, mystérieux, et même parfois mystificateur, vous est heureusement connu. Vous avez apprecié son dessin élégant, la delicatesse de ses colorations, la richesse de son imagination dans les détails, la perfection de sa technique.

Mais nous avons James Ensor, à qui le grand poète belge Émile Verhaeren a consacré une monographie copieuse et que je sens trop complexe et inquiétant pour oser l'exécuter en cinq . . . phrases.

Et Alexandre Struys, qui a des œuvres dans tous les musées.

Et Théo Van Rysselberghe, portraitiste et paysagiste tout à fait moderne, féru des formules récentes, artiste éminent que Paris et la société cosmopolite un peu d'avant garde ont adopté.

Eugène Laermans, sourd et muet de naissance, interprète un peu gauche, un peu sommaire, un peu brutal parfois, mais toujours éloquent quand il nous montre la misère des humbles. Ses œuvres sont rehaussées par l'attrait d'un coloris rare et original, et un certain air d'être inspirées par notre grand Pierre Breughel. Armand Rassenfosse, Auguste Donnay, sont les peintres de la femme, et du terroir wallon, Charles Mertens et Émile Vloors sont parmi les "*encore jeunes maîtres*," des notoriétés de bon aloi de la ville d'Anvers.

Oleffe eut des débuts éclatants, et pareillement Henri Thomas. En vérité, ils sont trop ! Je devrais vous parler aussi du groupe des peintres idéalistes spécialistes de peinture monumentale.

Jean Delville, qui est connu ici puisqu'il fut professeur à Glasgow, Montald, Fabry, Ciamberlani. Combien je passe de noms et combien parmi les morts eussent dû être cités.

Félicien Rops, inquiétant, pervers, dessinateur merveilleusement incisif.

Théodore Verstraeten, qu'une exposition d'ensemble posthume, à Anvers a mis fort en relief.

Isidore Verheyden, auteur du portrait de Constantin Meunier, et Henri Evenepoel, un élève excellent de Gustave Moreau, fauché à vingt-huit ans, et dont beaucoup de musées belges et étrangers (Paris, Vienne, etc.) se sont disputé les toiles — espérance déçue sur laquelle je m'arrête avec tristesse et conclus.

Je vous ai montré, mesdames et messieurs, beaucoup d'images et commenté sommairement beaucoup de personnalités de peintres. Mais j'ai un peu menti à mon titre, et je n'ai pas eu le temps—ni le talent—de vous montrer une évolution, un développement normal, se transformant peu à peu sous des influences successives, vers le progrès, ou vers ce que nous croyons un idéal artistique. J'ai laissé à ces images sur l'écran et aussi à votre imagination le pouvoir des déductions et des vues générales, des vues d'ensemble. Je vous demande seulement d'acquiescer à ma constatation que notre école belge au dix-neuvième siècle fut, et est encore maintenant, très touffue et riche en talents originaux, nombreux et variés. Peut-être peut-on apercevoir chez certains de nos peintres une certaine maladresse, une certaine inaptitude à tirer parti d'un réel talent, de beaux dons, d'indiscutables qualités plastiques. On voudrait parfois chez eux plus de maturité d'esprit, plus

de réflexion, l'indication d'une mentalité cultivée capable d'extérioriser des conceptions moins matérielles. Mais cela est une lacune inhérente à la plupart des écoles et spécialement à celles qui groupent des hommes goûtant, par tempérament, la sensualité de la vision, la beauté extérieure des choses, et qui s'épuisent à la rendre dans son éclat éphémère.

Cet éclat des choses belles, des surfaces sur lesquelles jouent les lumières et les ombres, n'est-il pas, après tout, le domaine essentiel des peintres ? En dehors de cela, pour eux, tout le reste n'est-il pas "littérature" ?

The Chairman (Lord Sanderson, G.C.B., K.C.M.G.) said he was sure all present would wish that he should express to M. Lambotte their grateful thanks for the very interesting lecture he had given, which had been accompanied by a remarkable series of illustrations. M. Lambotte's enforced exile had been the Society's opportunity, but he was sure all the members hoped that it would not be long before the lecturer resumed his sway at Brussels, where they might have the opportunity of seeing in their real colouring in the museums of the country some of the beautiful pictures which had been described There were two ways, in his experience, of looking at sights of different kinds in foreign countries. The first was to read a guide-book beforehand, and then go and look at them, which was rather a severe method. The second was to go and look at them, and come back and read the guide-book and discover what they had not seen, which was rather a disappointing method. Those who had listened to the lecture would be provided with a general knowledge of what they ought to go and look at.

The resolution of thanks was carried, and the meeting terminated.

THE FLOWER TRADE BETWEEN FRANCE AND ITALY.

Until 1908, the Italian wholesale exporters of flowers were amongst the best customers of the growers in France. The conditions which now prevail in this trade have undergone considerable change during the last five or six years. The cultivation of flowers on the Ligurian coast has increased to such an extent that the export firms in Italy are now able to obtain their supply of flowers from the home markets.

Formerly only the commonest kinds of flowers were cultivated in Italy, so that it was necessary to import the more choice blooms, such as the stove-grown roses and carnations, from France to the value of upwards of 1½ million francs (£60,000) every year. This did not include the value of the consignments sent direct by the growers to the retail florists in the principal towns in Italy. On the other hand, large quantities of rose trees, carnations, and other plants were sent to France by the Italian nurserymen. In 1911 consignments of cut flowers from Italy amounted to 804 tons, half of which were roses and carnations and the remainder stocks, violets, anthemis, etc.

This cross-current of exchange may be accounted for by the difference in the flowering seasons of the two countries, and competition is not to be feared except in February, for the reason that those grown in the open in Italy and sheltered only by matting do not bloom so early as the French plants.

In France the first flowering season for roses grown in the open air finishes in December, whilst those of Italy, which are remarkable for the beauty of their colouring and length of stalk, are available in January and February, before those grown under glass on the French side are ready for market.

If the open-air carnations of Italy are less choice than those grown under glass in the neighbouring country, they are, on the other hand, more rigid and travel better.

This mutual exchange gives employment to about a hundred or more small dealers in France, who cross the frontier daily with their produce, which they sell at Ventimille, Ospedaletti, or San Remo. They return to their homes in the evening laden with other flowers purchased at Ventimille, which are sold the following morning at the markets of Nice, Antibes, Cannes, and even Hyères.

During the season large quantities of roses for the distilleries at Grasse are brought daily from Italy. They are sent in sacks, which now must be sealed and accompanied by a certificate signed by a Government official to the effect that they came from a district unaffected by *disapsis pentagona*. Considering the importance of this trade, it is not surprising that a great outcry was raised on both sides of the frontier by those interested at the restrictions placed by the Government on the introduction of Italian flowers, many of which now have been removed. Cut flowers are now permitted to enter France from November 1st to May 1st, after which they must be accompanied by a certificate from the competent authorities appointed by the Italian Government as to their freedom from disease.

EXTERMINATION OF FLIES AND MOSQUITOES.

A French journal, *L'Agriculture Nouvelle*, gives an account of some experiments made by M. Lang, a veterinary surgeon, in the French colonial service at Noumea (New Caledonia), for the extermination of a species of horse-fly which infested the animals under his charge. This insect, which appears to be very tenacious of life and difficult to kill, is only driven away for a short time by applications of cocoa-nut oil, oil of juniper

berries and petroleum, and quickly returns to resume its attacks. Wounds or sores are very difficult to heal on this account, as the insect is a carrier of contagion.

The remedy, which is simple and is said to be effective, consists merely in anointing those parts of the body of the animal infested with these pests with cod-liver oil. The flies are killed immediately by contact with the oil. No caustic effect to the skin of the animal is produced by this oil as is the case with other fish oils.

The application of cod-liver oil is equally efficacious for the extermination of the common house-fly as well as the mosquito. Ticks, which infest dogs, sheep, and other animals, can be readily destroyed by an application of cod-liver oil. The effect of these applications lasts from ten to eighteen hours.

Spread on the surface of pools of water this oil has the effect of killing immediately the larva of the mosquito.

NEW USES FOR BY-PRODUCTS OF HENEQUEN IN MEXICO.

Several new processes have been recently discovered for using by-products of the henequen plant, which will favourably affect the fibre industry of Mexico, particularly in the States of Yucatan and Campeche. For many years methods have been sought to utilise the waste from henequen leaves after extraction of the fibre, but without much success, but recently certain experiments made with the object of discovering a perfect machine for simplifying labour in extracting fibre from the leaves, and for utilising the by-products, have proved successful. A machine has now been invented which is intended to reduce the labour in feeding the leaves into decorticating machines. One man feeds the leaves directly to the decorticators, and takes the place of six to ten labourers previously necessary. It is anticipated that a large number of similar machines will be manufactured for sale to the many henequen plantations in Mexico. In addition, experiments are being made with machinery for manufacturing paper from henequen-plant stumps, which have heretofore not been utilised. The experiments so far made have been successful. Henequen plants, after a number of years, fail to produce leaves of such quality that they can be utilised for fibre, according to the United States Consul at Progress, Yucatan. The stumps are left on the ground and destroyed. This is done at considerable expense, and any method by which they can be used adds to the farmers' profits. The new process accomplishes this, and it is proposed to erect paper factories on henequen plantations for utilising these stumps if the process proves as satisfactory as seems probable. It is said that not only can the stumps be utilised, but also the waste from the leaves known as "bagazo," enormous quantities of which are left to rot outside all henequen fibre factories. The paper, it is stated, can be produced from the stumps and "bagazo" in commercially satisfactory quantities, and sold on local markets at one-quarter to one-third the price of any other paper on the market. It is not probable that this paper will be exported to any great extent, as there is a sufficient market in Mexico for the quality which will be produced, but if the manufacture is carried out as extensively as anticipated it must have a large effect on the paper market in Mexico. The paper, which has been manufactured in experimental quantities, consists of brown, heavy quality paper, a dull buff colour, partially-bleached thinner paper, and a completely-bleached cream paper of excellent quality, similar to other wood-fibre papers, but of exceptional strength. It is stated that there will probably be a large demand for the machines referred to above. If the plan proves as successful as it is hoped, a larger income will be obtained by the henequen planters of Yucatan, especially as it contemplates the use of materials which have heretofore not only been without commercial value, but whose destruction has been a continual annual expense to the planters. In addition to the paper produced, alcohol is also produced from the stumps and "bagazo" by the same process.

THE PANAMA CANAL FROM AN ITALIAN VIEW POINT.

The probable effects on the world's trade, and on Italian commerce in particular, by the opening of the Panama Canal, appear to have been very carefully examined by Dr. Giovanni Tempini in "Il Canale di Panama," published by L' Instituto Italiano per l' espansione Commerciale e Coloniale of Venice. Commencing with a brief history of the undertaking, the author ascribes its earliest conception to Angelo Saavedra, who, in 1520, first proposed the cutting of an inter-oceanic waterway across the Isthmus of Darien. The *raison d'être* of the canal and its advantages to the United States first and foremost are too well known to English readers to need repetition here. England, amongst the nations of Europe, will certainly be the chief gainer by its construction, whilst France, Germany, Belgium, and Holland may benefit in a lesser degree. With regard to Italy, the author takes a decidedly pessimistic view. The shortening of the distance by sea between New York and Yokohama will enable the Japanese to flood the markets of the Eastern States with raw and manufactured silk to the detriment of Italian industry, by which they are at present supplied. Californian wines, canned goods, and other produce of the Pacific Coast will rapidly displace Italian in the markets of North America. The author urges his fellow-countrymen to cultivate commercial relations with other nations of the Latin race in the South American continent, and more especially with Peru and Chili. The new route to these countries on the Pacific Coast will no doubt attract Italian emigration, and open up fresh markets for goods of every description.

KAPOK CULTIVATION IN CEYLON.

Recent inquiries from Europe and the United States seem to indicate that a considerable commercial interest has developed in the production and uses of kapok. The kapok is a tropical tree found largely in both the East and West Indies. Another species, not so tall, is found in Mexico. In the East Indies the tree is more largely cultivated as a crop in Java and in the Philippines. Under American rule in the Philippine Islands, according to the American Consul at Colombo, the cultivation of kapok has been scientifically studied and developed to a certain extent along modern agricultural lines. In Java, however, from which place considerable quantities are exported to Europe, kapok is cultivated only as a secondary crop, and the methods employed in its production are primitive. In Ceylon, kapok could hardly be described as a seriously cultivated crop at all, though it is one of the easily-grown products of the island. It is generally planted along the roadside and around the boundaries of gardens, as a sort of extra crop from what would otherwise be waste land. About the environs of Colombo the tree is largely grown as a border tree for canals and earthworks, where erosion might otherwise destroy the banks. It has a wide distribution, however, over the low country, and up to an altitude of 2,000 ft. The kapok is a fairly tall, gaunt, deciduous tree with a straight trunk, and its many branches jutting out in groups of three at right angles to the bole, make it easily recognisable. The peculiar odour of its flowers has a strong attraction for bats, and consequently flowers are destroyed by thousands which would otherwise produce pods of the silky floss or kapok of commerce. One of the drawbacks against attempting to cultivate the tree in Ceylon with the expectation of any large profits is the presence of these bats in immense numbers. The principal obstacles so far encountered in its cultivation, however, are the cost of labour, as compared with the price paid for the product, and the difficulty of gathering the crop. Most of the pods containing the floss grow on the end of the branches, and it is not easy to induce the labourer to take the risk of gathering them among these slender branches at a considerable height from the ground. The use of step-ladders as a means of gathering crops has never been introduced in Ceylon, and it is hardly probable that for such a crop as kapok alone they could be employed with advantage. Moreover, the business of gathering the ripened pods is a rather slow one, as only the most careful and experienced coolies can tell when they are ready for harvesting. Before ripening, the kapok pods are of a light green colour and smooth, but at the right time they become wrinkled and brownish. If left even for a few days longer the floss often loses its lustre and soft quality, and is of little value. Most of the kapok now being exported from Ceylon comes from the Matale district to the north of Kandy. In this district the tree does not grow so tall, and with low outstanding branches is more like a shrub; it is, therefore, easier to gather the pods. The pods are picked by hand and cured by being allowed to dry thoroughly in thatched sheds at the homes of the villagers. They are then broken, and the "cotton" or floss is roughly hand-cleaned by coolie women. It is then packed in bales and sent to Colombo, where the seeds are removed by special machines.

VITICULTURE IN PERU.

Before its introduction into Peru the vine was imported into South America, at the beginning of the sixteenth century, by Francesco Caravantes, and according to M. Molinatti, an Italian viticultural expert, grapes were eaten at Cuzco, Peru, for the first time in 1555. At the present day the varieties of vine stocks existing in Peru are as follows: The most common is the Quebranta, then come the Negra and the Moyar. Less known are the Albilla and the Rosada, as well as the aromatic vines, Italia and Moscatel. After these—but at a long distance—are classed the Française, and last of all the Barbera, Alicante-Bouchez, Grand Noir de la Calmatte and Teinturier. In the Department of Moquegua are found the Sémillon and Sauvignon, and in the Department of Chincha, the Isabella. The three first varieties, which are local vines probably derived from the original vines imported into Peru, are the most productive. The others have a less prolific yield, and come from various vine-growing countries. The most productive vine of all is the Quebranta, which yields a wine which is, however, somewhat insipid. This vine suffers neither from the oidium nor the peronospora, pests which are very prevalent in Peruvian vineyards. Quebranta, Negra, Moyar and Moscatel yield black grapes, but the wines produced from them are not particularly good. These grapes, however, are largely cultivated for brandy making. The Albilla and Italia are very susceptible to attacks of the oidium and peronospora. The Albilla is sometimes mistaken for the Folle Blanche de la Charente, but the species are quite distinct. The Italia is one of the most highly appreciated vines in Peru. The grapes from this vine are held in high repute, and much business is done in them as fruit for the table. The Rosada has no particular value from a commercial point of view. The Moyar is used to fortify other wines. Wine from La Française has a distinct taste, it is said, of pitch. It is used for blending with other wines. The other vines do not call for any special mention, but they are all used in the production of wine which is consumed in Peru.

ABYSSINIA AND ITS TRADE.

The commercial future of Abyssinia, judging from the last report on the trade, is full of promise, for the country is naturally very rich and bears a large population with an aptitude for trade. This trade is as yet in its infancy, large tracts being up

till now practically unexploited. Development is, however, rapidly proceeding. Generally speaking, the southern half of Abyssinia is richer than the northern, and the districts in which trade is most highly developed are those of Jimma and Kaffa in the south west and of Harrar in the east. Adis Ababa, the seat of the central government, has a population of from 40,000 to 50,000, which fluctuates according to the number of troops which happen to be quartered in the town; the foreign population, viz, merchants, contractors, artisans, etc., numbers about 1,200, and consists largely of Indians, Greeks, and Arabs. Legations are maintained by the United Kingdom, France, Italy, Russia, and Germany, and a Consulate-General by the United States. Among the chief business offices are two telegraph offices, a postal service, a telephone system, and a custom house. Adis Ababa will be the terminus of the Franco-Ethiopian Railway. There are two hotels with comfortable accommodation, at which rates *en pension* are £6 and £5 per month. There is a large market place, which presents a busy appearance, and where on Saturday (the market day) a great concourse of people assembles from the surrounding country.

The Government has recently erected an electric power-station on the River Akaki, some 18 miles from Adis Ababa. The current is already laid on to the Government cartridge factory, a mile outside the town, and there is a project on foot for the electric lighting of the town. Land in and around the town is privately owned and very costly, as are also building materials and fuel; but it is anticipated that when the railway from Jibuti to the capital is completed, timber required for building purposes will probably be imported. There are forests of good timber that exist in various parts of the country, but these cannot be exploited owing to the difficulties of transport.

Harrar, which lies 6,000 feet above the sea, contains some 40,000 to 50,000 inhabitants, and is the centre of a rich coffee-producing district. A Chamber of Commerce was formed by the merchants at Harrar in 1914. The town has lost a good deal of its importance as a collecting centre owing to produce which formerly came thither now being taken direct to the stations on the Franco-Ethiopian Railway, this being, of course, the main avenue along which trade passes. At the end of 1913 goods were being received for transport as far as the Hawash River, 227 kilometres from the capital, which was expected to be reached about the present time (1915). The figures of the goods conveyed by the railway show a steady increase during the past five years, and an abnormal increase in the imports in 1913.

The value of the trade between Abyssinia and the British Somaliland ports amounts to about £61,700, the principal articles of export being skins, hides, glue, coffee and grain. It was inevitable that the construction of a railway from the port of Jibuti into the interior should adversely affect the prosperity of the adjacent port of Zeyla. From 1901, when the railway was partially opened for traffic, the value of the Zeyla trade began to diminish steadily till 1907-8; but since the latter year there has been a slow but steady revival.

Gondar, once the capital of Abyssinia, is now merely a collection of squalid huts clustered round the ruins of its former greatness. There are considerable possibilities, however, for trade in this corner of Abyssinia. The Italian Government has maintained a commercial agent and a doctor at Gondar for the last four years, while a British Consul for N.W. Abyssinia is also stationed there. Another convenient centre for trade is Gore, in the west, the headquarters of the British Consul for Western Abyssinia, and here the Bank of Abyssinia and several business firms have opened branches.

In the Adis Ababa export trade hides and skins are the largest item, 4,105 metric tons being exported by the railway in 1913. In normal times these are mostly exported to Hamburg, Havre, Marseilles, and Salonica, whence a considerable quantity find their way to the United States. Coffee is of two sorts—the Harrari, a fine yellow berry, which is mostly sent to Aden, where it is mixed with Mocha coffee and sold as "long-berry Mocha" in the United Kingdom and America. The other sort is Abyssinian coffee, the most important product of the south-west, where enormous forests of it grow wild and are hardly as yet exploited. There being a sufficient demand in Khartoum to absorb all that comes on to the market, practically the whole of this coffee finds its way out through Gambela on the River Baro, a tributary of the White Nile, by which way it reaches its destination by water. Other products include wax, ivory, rubber, civet and gold. Ivory and rubber are Government monopolies. Gold is washed by the natives in many of the rivers, and though so far the spasmodic efforts of prospectors have not met with much success, it is more than probable that some day the discovery of gold in sufficient quantities to make dredging operations pay will be made. At present the annual export of gold amounts to about £50,000; the total production is, doubtless, considerably more

ARTS AND CRAFTS.

The Exhibition at Goldsmiths' Hall.—**The exhibition of German and Austrian articles typifying successful design, held under the auspices of the Board of Trade at Goldsmiths' Hall, though it was only open for three days, aroused a good deal of comment, both favourable and unfavourable. That was due in a measure to the exhibition itself, but also in part to the literature circulated, both by the Board and by some half-dozen art workers, who advocate the foundation of a Design and Industries' Association, and who, by their whole-hearted enthusiasm for the work shown, did much to convince hesitating visitors of its excellence. With regard to the works exhibited, while there is**

no doubt whatever about their interest, there seems some danger that their significance and importance may be over-estimated in certain quarters. In the first place, it has to be remembered that the work shown at Goldsmiths' Hall, though it adequately represents a certain advanced type of German and Austrian manufacture, is by no means typical of German production as a whole, some of which—it would not be altogether unfair to say, much of which—is at least as dull and lifeless as anything produced in this country. Again, the exhibits represent what has found its way, for one reason or another, into Great Britain. There is no record of how the various objects have sold, or whether they can lay any claim to have been a commercial success. It looks, upon the face of it, as though the printed cottons and linens (all of them apparently Austrian, by the way) which made such a striking show at the exhibition, while they would undoubtedly attract attention in a shop window and be a useful extra line to help to introduce other goods, would only command a very limited sale. They were well worth study, for though some of them were delirious enough to justify the remark of a depressed manufacturer, who declared that if he produced stuff like that he would soon be ruined, there was a certain freshness about them, a clever recognition of the possibilities of black and of outline, a daring and occasionally happy use of bright colour, which made them very full of life It is worth recalling that the German cotton prints exhibited by the Board of Trade at Cheapside some weeks ago were dull and hackneyed in the extreme. This, combined with the fact that the very few wall-paper designs shown at Goldsmiths' Hall were not peculiarly fresh or original, leads one to wonder whether the statement in the official pamphlet that "a large section of the public is sympathetic towards original efforts, and hitherto their demand has been largely met by foreign productions. An instance of this is that half the wall-paper designs issued by the principal wall-paper manufacturers in this country are believed to have been designed abroad," is not rather misleading. It is always difficult to get at facts of this kind; but undoubtedly a considerable proportion of the foreign designs brought over here are purchased, not because they are original, but for a variety of other reasons. There are certain styles, for instance, demanded by the public which a Frenchman can handle successfully and an Englishman cannot. (There is, of course, no denying that many of the foreign patterns bought are French and not German.) There are certain technical conditions to which foreign designers are sometimes more ready to conform than British artists. Again, some of our best English paper-stainers procure their designs mainly, if not entirely, from native sources. In the face of all this, it is by no means safe to assume, without further proof than seems to be forthcoming, that the bulk of foreign patterns used in this country represent the newest or the best type of work, though some of them possibly do. Nevertheless in various simpler branches of design and workmanship there is abundant evidence that the German work is very much alive. People who covered their floors with linoleum chosen from the small samples shown would probably be more than a little disappointed with its effect when it was laid, but purchasers of smaller articles would have no cause to repent of their bargain. The collection of cardboard and tin boxes for cigarettes and the like showed much more cleverness than work of the same type designed over here, and the posters were a striking proof of what excellent cheap lithographic work is being done in Germany. Most of our best posters are designed for the three-colour process, but the German examples shown the other day prove beyond all gainsaying what good results can be achieved in this direction by a scientific use of lithography. Of the printing and general get-up of some of the catalogues and cheap books it would be difficult to speak too highly. The replicas of peasant pottery are on the whole better made than our own work of this kind, but the texture of the glaze of some of the "leadless glaze" ware was unpleasant in the extreme, whilst the more or less artistic cheap crockery probably appeals rather to those who see it for the first time than to the people who have met its like in numerous foreign hotels and restaurants. Further, the official note on ceramics, while it shows that its writer is well up in modern German production, makes rather scant acknowledgment of all that is being done over here. It is true that we are producing quantities of dull and inartistic designs and objects, but we are also doing some good and original work. Moreover there is evidence in the pottery as in other crafts of Germany's talent for borrowing. It looks as though her success may be in no small measure due to the inadequacy of the international arrangements for copyrighting designs. It is, to say the least of it, hard when a good design for which a fair price has been paid has to compete in the open market with a rather inferior rendering of itself sold at a much lower figure. There is room, plenty of it, for improvement in our design, but we shall hardly arrive at it by setting up German cleverness, which has succeeded partly through its imitation of us, partly through its not entirely commendable business methods, as a standard worthy of unbounded admiration. It is easy to praise the work shown at Goldsmiths' Hall and to say, with its admirers, that it represents a national ideal, but have we adequate proof that it does so? Besides, it has to be borne in mind that the national ideals of Germany, Austria and Hungary are not, to say the least of it, identical in the artistic any more than in the political sphere.

Design and Industry.—The plea for the foundation of a Design and Industries' Association put forward by the unofficial committee responsible for

the Memorial as to Industrial Design, and circulated at the Goldsmiths' Hall exhibition, comes at a good moment, and its object, the association of manufacturers, designers, distributors and others interested in order to encourage the production under ordinary commercial conditions of attractive and carefully-designed modern work, is wholly commendable. It is only too true, as the writers of "Design and Industry" urge, that hitherto "the designer and the manufacturer have...largely remained in separate compartments, and that the purchasing public had yet a third point of view." But an amelioration of that state of affairs can only come about when each of the three parties cries *peccavi*. No amount of pointing out their obvious duties to the other sinners by any one of the offenders will bring about the desired result, since the existing muddle is the outcome of faults on all sides, and not of one party alone. The authors of this appeal are artists, they naturally see that the manufacturers have been at fault. They rightly point to our Arts and Crafts movement as the fount and origin of the German advance, and they state the benefits which would accrue if the designer and the manufacturer came into touch by the simple process of "the employment of the best available talent." There is, however, one point which they seem to leave out of account. The Arts and Crafts movement in this country began as a movement more or less on the lines of the proposed association. It included within its ranks not only craftsmen, but "paper designers" and even manufacturers. That it has in some measure failed to attain the larger ends to which it originally aspired is due, no doubt, partly to the manufacturers and the general public, but also in no small measure to the younger generation of artist-craftsmen themselves who have been so carried away by the glamour of making something with their own hands that they have had little but contempt to offer to manufacture and everything connected with it. If they have repented of this attitude, or if a still younger generation is arising ready to give of its best to help forward the artistic interests of production on a large scale, not from a lofty and far distant height, but as loyal co-operators with the manufacturers, convinced that in so doing they are really furthering the highest claims of art, there is good hope that things may improve.

CORRESPONDENCE.

CUTCH IN MALAYA.

I am desired by the court to inform you that their attention has been drawn to an article which appeared in the issue of your *Journal* dated March 26th, on the above subject.

In paragraph two of the article particulars are given of the quantity and value of the product imported into the colony during the year 1913. It is noted that no mention is made of cutch manufactured in North Borneo, but it may interest you to know that in that year the product to the value of £23,423 was exported from the territory.

It has occurred to the court that you might care to supplement the article referred to by these figures.

HARINGTON G. FORBES, Secretary.

The British North Borneo Co.,
37, Threadneedle Street, London, E.C.
March 31st, 1915.

[The article in question was based on a report of the Malay States Information Agency, and the statistics only referred to the amount of cutch imported into the ports of the colony.—ED.]

OBITUARY.

LORD ROTHSCHILD, G.C.V.O.—The financial world has suffered a severe loss by the death of Lord Rothschild, which took place at his residence in Piccadilly on March 31st.

Nathan Mayer de Rothschild was born in 1840; he was educated privately and at Trinity College, Cambridge, and on leaving the University he entered the famous office in New Court, St. Swithin's Lane, which was directed by his father, Baron Lionel de Rothschild, with the assistance of his two brothers, Baron Mayer de Rothschild, and Sir Anthony, the President of the Jews' Free School.

The part played in British finance by the house of Rothschild is common knowledge. One of their greatest feats was to arrange the purchase by the British Government in 1875 of the 176,602 shares in the Suez Canal Company, owned by the Khedive Ismail. The transaction involved the enormous sum of nearly £4,000,000, but it was carried out with extraordinary ease and smoothness. The late Lord Rothschild also took an important share in reforming the finances in Egypt during the difficult period 1878-88, and the present condition of the country is due in no small measure to the services of his firm. He had also large interests in South America.

In 1865 Mr. Rothschild (as he then was) entered the House of Commons as member for Aylesbury—a seat which he occupied till 1885, when he was created a peer. He was naturally regarded in the House as the recognised authority on all financial matters. At first he was a follower of Mr. Gladstone, but he was unable to accept the Home Rule Bill, and he became a Unionist Free-Trader.

As is generally known, Lord Rothschild took a deep interest in the welfare of the Anglo-Jewish community, of which, like his father, he was considered the head. He was a most generous benefactor of all Anglo-Jewish institutions, his private benefactions and those of his firm being alike munificent.

Nor was his generosity by any means limited to Anglo-Jewish charities. His purse was always open to any deserving cause. Among the last

tasks which he undertook was the chairmanship of the council of the British Red Cross Society, to which over £1,000,000 has been contributed since the outbreak of the war.

His services to the agricultural industry should not remain unmentioned. In the breeding of pure-bred stock, Tring Park made a world-wide reputation. In horses, cattle, sheep, as well as poultry and dairying, it was regarded as an example to all, and in each of these sections Lord Rothschild himself took the warmest interest.

Lord Rothschild became a member of the Royal Society of Arts in 1887. In 1901 he was elected on to the Council, on which he served as Vice-President till 1905.

NOTES ON BOOKS.

First Principles of Production. By J. Taylor Peddie, F.S.S. London: Longmans, Green & Co. 5s. net.

Of recent years, and especially of recent months, a very great deal has been talked and written about the connection between science and industry. The question is undoubtedly of the first importance to us as a nation, and the more it is discussed—provided, of course, that the discussion eventually leads to something practical—the better it will be for the prospects of our industrial prosperity. For this reason we may extend a welcome to Mr. Taylor Peddie's volume, which is perhaps the more interesting, as the author approaches the subject from the industrial point of view, whereas most of those who have hitherto taken part in the discussion have spoken from the scientific side. The book consists of a number of articles, the main object of which is "to open up a series of opportunities from the workman at the machine to the student at the university." Most of these are from Mr. Taylor Peddie's pen; but he also includes articles on "The Co-operation of Science and Industry," by Mr. S. Roy Illingworth; on "The Influence of Brain Power on History and Industry," by Sir Norman Lockyer; on "Steel Industry: Opportunities for Britain," by Dr. William Lorimer; and on "The Chemical Industries of Germany," by Professor Percy Frankland.

To Fellows of this Society, who have attended the meetings held here during the present session, or read the reports thereof in the *Journal*, there will not be very much that is fresh in what Mr. Taylor Peddie tells us of the respective conditions of industry in Britain and Germany. Possibly his most interesting article is that which deals with "Finance and Industry." Dr. W. R. Ormandy, in a paper read before the Society in December last, described the part which the German banks play in assisting industrial development. There can be little doubt that this attitude of the German financiers accounts as much as anything for the extraordinarily rapid growth of German industry, and it is to be hoped that in this respect our banks may learn to take a leaf out of the German book; but, as Mr. Taylor Peddie points out, this system could only be adopted in this country with reservations. "The policy of advancing loans on the strength of prospective orders to individuals who do not possess established businesses is very unsound for the reason that costs of production during the first three years of the life of a business cannot be gauged with any degree of accuracy, even assuming the efficiency of the management to be good. The works have to be first of all created, then the right kind of machinery and labour has to be obtained, skilful managers selected, and last, but not least, good managing directors must be secured. The whole organisation then has to carry out tests and experiments, and tune itself up to work cohesively and efficiently in production. As the cost of completing the organisation, therefore, cannot be gauged with any degree of accuracy, it will be seen that any bank advancing loans without security to establish a new industry is embarking upon business of a highly speculative nature." These words, no doubt, represent with sufficient accuracy the conservative attitude of the British banker; but if the British manufacturer is to be lashed—as he has been for the last twenty years—for his failure to encourage the co-operation of science and industry, why should the British banker go scot-free when he is committing the same offence?

We have heard a great deal about the organising and administrative ability of the Germans, and a corresponding amount about our own methods of "muddling through." This is natural enough in a people that is always ready to see its own faults, and the virtues of others; but there are among us a certain number who venture to doubt whether Germany is after all so wonderful in this respect. Professor W. J. Ashley, for instance, who certainly speaks with high authority here, said at a recent meeting of this Society: "I decline to take it [the German Beamtenthum] quite at its face value. It makes a proud and justifiable display of all its achievements, but I doubt if it can show anything quite so big as the way in which this country took up the colossal task, not only of sickness insurance, but also of unemployed insurance—which German administrators had been afraid to tackle and all in a single year."

Mr. Taylor Peddie appears to be of those who believe that we are far behind our enemies in the matter of organisation, and the chief remedy he proposes is "to see that a proper commercial and technical educational system is established in the universities, technical colleges, and secondary schools in Great Britain. We must establish a B.Sc. degree in Industry, and assist in the drafting of the curriculum."

There are, no doubt, many intricate problems to be studied in connection with industry, as a glance at the syllabuses of the lectures delivered at such a college as the London School of Economics will

show; but is it yet proved that the kind of course which would lead to a B.Sc. in Industry is the best to turn out organisers? In a paper which was read here in 1912, Mr. H. A. Roberts, Secretary to the University of Cambridge Appointments Board, mentioned that of a certain group of 50 Cambridge men employed in commerce by five or six great organisations, 19 graduated in classics, 5 in history, 5 in law, 1 in theology, 4 in modern languages, 8 in mathematics, 5 in engineering, and 8 in natural sciences. "The classical ability," he added, "shows up extremely well." And what educational system was responsible for Mr. Lloyd George's "discovery of the war"—the man who organised the transport of our army to France? Winchester and Oxford—perhaps the most unpractical system of acquiring useless knowledge that even this country can boast. The gigantic task mentioned by Professor Ashley of establishing both sickness and unemployment insurance was also almost entirely the work of men of similar training.

Whilst we are all one in the desire to do everything possible to improve the condition of British industry, there are at least two schools of thought as to the way in which it should be done Would the commercialising of the universities assist? We doubt it, and even if it did so, what would be the price? Important as industrial prosperity may be, it is not everything. Germany has staked almost all on securing it, and to achieve her end she has not hesitated to use in business methods similar to those which have made her name infamous in war. Is commercial prosperity worth having at the cost of one's good name? It is not suggested that the effect of studying political economy demoralises one's sense of honour; but if material success is made our chief criterion, there is a danger of losing sight of those higher ideals which have certainly raised us above the level of Teutonic culture, and which have found their principal home in the older unpractical universities.

GENERAL NOTES.

British Industries Fair.—As a complement to the series of Exchange Meetings which have been organised by the Board of Trade in the last few months, at which samples of German and Austrian goods have been exhibited with a view to finding British manufacturers prepared to make goods to compete with them, a display of samples of British goods in a number of the trades in connection with which the Exchange Meetings have been held is now being organised. This display is intended to reproduce the main features of the well-known Leipzig Fair. It will be held at the Royal Agricultural Hall, London, from May 10th to 21st, and will be styled "The British Industries Fair." Only British manufacturing firms will be permitted to exhibit. No exhibitor may exhibit articles other than those of his own manufacture and included in the following trades: Toy and games trade, earthenware and china trade, glass trade, fancy goods trade, cutlery trade, electro-plate trade, clock trade, jewellery and drapers' jewellery trades, including buttons, studs, push-buttons, pins and needles, stationery and printing trade. The Board of Trade will undertake, among other things, the preparation of a catalogue of exhibitors and the general decoration of the hall.

Mercantile Marine of the World.—The following figures, published lately in America, show the tonnage of the seven principal merchant navies of the world in order of their importance:—

	Gross Tonnage.
Great Britain	20,075,791
Germany	4,998,746
United States	3,489,736
Norway	2,475,324
France	2,246,504
Japan	1,700,062
Italy	1,571,761

From this it will be seen that the tonnage of the British merchant shipping is about four millions greater than that of the six other countries taken together. It should be noted that the figures for the United States include about one and a half millions of tonnage of shipping on the great American lakes, and should be deducted, in order to compare fairly with the other nations, and the United States would therefore occupy the fifth instead of the third place, coming between France and Japan in the above list.

"Pusa 12" Wheat.—The *Agricultural Journal of India* for January contains further information about "Pusa 12," the wheat that seems to have a great future before it, thanks to the scientific work done by Mr. A. Howard, Imperial Economic Botanist, and his wife as his personal assistant, and Mr. Leake. The environment experiments undertaken from 1909 onwards showed that all the Pusa varieties did well in Bihar, the United Provinces, and Central India; but one variety gave equally good results in the Punjab, United Provinces, South Bihar, and the Central Provinces. This was "Pusa 12," and it proved itself to be the best wheat for India as a whole, both as regards yield and quality. The cultivators themselves grew the variety from seed supplied to them; so the experiments were absolutely fair in different parts of the country. We are told that "Pusa 12" has another advantage in addition to its yielding power and quality, namely, its characteristic appearance in the field which distinguishes it at once from the country wheats. "The beardless ears are long, with shining red chaff, and the straw is quite different in tint from that of most Indian wheats. Its appearance in the field and the large elongated grain enable this variety to be instantly distinguished. In any scheme of seed distribution, which aims at replacing the existing wheats by a new kind, it is a great advantage if the improved variety can easily be recognised in the field and in

the market." The time appears to have come for the establishment of this improved grade of white wheat over a large area of the wheat-growing tracts in India, and the wheat must be brought to the notice of the Home millers in the form of one or two experimental shipments, so that they may have an opportunity of getting first-hand experience of its qualities and behaviour. Then will come an efficient organisation of the seed-supply so that all demands can be met. In Bihar the bulk of the seed raised in the seed-farms in the province is to be concentrated into a single circle; and in the United Provinces the central circle has been chosen for work, mainly on account of the local development of the co-operative credit movement and of the close working arrangements that exist between the societies and the Agricultural Department. By means of the societies an effort will be made to replace the existing wheats as far as possible by the new kind, and to supply the trade with as much surplus seed as can be obtained. At the earliest moment this will be secured for the first shipments to Europe. In the work of buying in the seed and in placing it on the markets in Europe to the best advantage the interest and assistance of Messrs. Ralli Brothers have been secured. Mr. A. E. Humphries, a former President of the Incorporated Association of British and Irish Millers, has promised to bring the matter before the Home millers and assist in the establishment of the new grade in England as soon as the first shipment has been collected.

HONG-KONG'S WIRELESS STATION. — Writing from Hong-Kong on the subject of the long-discussed wireless telegraph for Hong-Kong, which is at last to be carried out, the American Consul-General there says that the proposed radius of service has been enlarged to 500 to 700 miles per day and 1,800 miles or over by night under normal conditions, and the plant is expected to be in operation within five months. The inauguration of this service has some additional importance in view of the fact that the large wireless stations of the Chinese Government at Canton and Woosung, near Shanghai, are now working, and those at Foochow and Hankow will be completed by the time the Hong-Kong station is in working order. The service of the two Chinese stations now ready was commenced with the beginning of the year. They cover substantially the same radius as the Hong-Kong station, the plants thus being able to exchange messages with each other as with all ships in Chinese waters. A typhoon warning service is one of the first features adopted by the new system. All these coast stations are of the same construction. The oscillating power in the antennæ radiating the waves is 5 kilowatts (6·7 horse-power) with a current of 32–38 amperes. An official statement reports that the stations are fitted out with a 28-horse-power benzine motor, driving a dynamo and supplying the necessary current for charging an accumulator battery, from which the current is then taken for transmission to the transmitting machinery. A "converter" run by this battery will supply an alternating current of 500 cycles per second, which is stepped up to some 10-1,200 volts. The plant produces waves with lengths between 600 and 3,000 metres. The receivers of all the stations can pick up waves of all lengths between 300 and 4,000 metres. The stations are manned by a Chinese staff educated by foreign experts in the Pekin College of Communications. The Woosung station has been opened for day and night service, and the Canton station is open from 8 a.m. to 10 p.m. The stations are supervised by managers with six to eight years' practical experience in wireless work.

AGRICULTURAL RESOURCES OF FRANCE.—The *Echo de Paris* announces the publication of a book entitled "Effort Agricole de la France pendant les Six Mois de Guerre," from the pen of M. Fernand David, the French Minister of Agriculture. It contains very reassuring information respecting the present supply of cereals and cattle in France. At the end of last year there were 13,300,000 head of horned cattle in France, as compared with 16,800,000 head at the end of 1913. The number of pigs was 6,280,000, as compared with 7,080,000 a twelvemonth ago.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock :—

APRIL 14. — T. THORNE BAKER, "The Industrial Uses of Radium."

APRIL 21.—MORETON FREWEN, "The State and the Fisherman."

APRIL 28.—A. S. E. ACKERMANN, B.Sc., Assoc. M.Inst.C.E., "The Utilisation of Solar Energy."

MAY 5. — AUGUSTUS VERNON HARCOURT, D.C.L., LL.D., D.Sc., F.R.S., "On the Measurement of the Efficiency of Domestic Fires, and on a Simple and Smokeless Grate."

MAY 12.—CHARLES R. DARLING, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry." SIR ROBERT ABBOTT HADFIELD, D.Sc., F.R.S., will preside.

ADDITIONAL LECTURE.

Thursday afternoon, at 4.30 o'clock :—

MAY 6.—M. PAUL LAMBOTTE, Directeur des Beaux-Arts au Ministère des Sciences et des Arts de Belgique, "Constantin Meunier et les Sculpteurs Belges de son Temps."

INDIAN SECTION.

Thursday afternoons :—

APRIL 15, at 5 p.m. — PERCEVAL LANDON, "Basra and the Shatt-ul-Arab." The RIGHT HON. EARL CURZON OF KEDLESTON, G.C.S.I., G.C.I.E., will preside.

May 13, at 4.30 p.m.—Sir Charles H. Armstrong, late Chairman, Bombay Chamber of Commerce, "Indian Trade and the War."

Colonial Section.

Tuesday afternoon, at 4.30 o'clock:—

May 4.—S. Chas. Phillips, M.S.C.I., "The Empire's Resources in Paper-making Materials." The Hon. Sir George H. Perley, K.C.M.G., Acting High Commissioner for Canada, will preside.

Date to be hereafter announced:—

C. H. Sherrill, "Ancient Stained Glass."

Cantor Lectures.

Monday evenings, at 8 o'clock:—

David Sommerville, B.A., M.D., M.R.C.P., D.P.H., "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

MEETINGS FOR THE ENSUING WEEK.

Monday, April 12...Victoria Institute, Central Hall, Westminster, S.W., 4.30 p.m. Mrs. W. Maunder, "Astronomical Allusions in Sacred Books of the East."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, Cleveland Institution of, Corporation-road, Middlesbrough, 7.30 p.m.

Surveyors' Institution, 12, Great George-street, S.W., 8 p.m. Messrs. C. S. Joseph and R. S. Gardiner, "The Report of the Land Enquiry Committee on Housing."

Tuesday, April 13...Electrical Engineers, Institution of (Local Section), 17, Albert-square, Manchester, 7.30 p.m. Mr. J. H. Rider, "The Power Supply of the Central Mining-Rand Mines Group."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. B. Fletcher, "The War on French Architecture."

Alpine Club, 23, Savile-row, W., 8.30 p.m.

Civil Engineers, Institution of, Great George-street, S.W., 8 p.m. Mr. C. W. Anderson, "On Impact Coefficients for Railway Girders."

British Decorators, Institute of, Painters' Hall, Little Trinity-lane, E.C., 8 p.m. Mr. H. C. Cleaver, "Russian Peasant Art and Life."

Photographic Society, 35, Russell-square, W.C., 8 p.m. Mr. R. E. Crowther, "Thio-indoxyl Development and its bearing on the Theory of the Latent Image."

Zoological Society, Regent's-park, N.W., 8.30 p.m. 1. Mr. G. A. Boulenger, "A List of the Snakes of the Belgian and Portuguese Congo, Northern Rhodesia, and Angola." 2. Dr. R. Broom, (a) "On some new Carnivorous Therapsids in the Collection of the British Museum", (b) "On the Organ of Jacobson and its Relations in the 'Insectivora.'" 3. Dr. G. E. Nicholls, "A Note on the Urostyle (*Os Coccygeum*) of the Anurous Amphibia." 4. Mr. E. Gibson, "Some Notes on the Ñato Breed of Cattle (*Bos taurus*)."

Engineers, Society of, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 7.30 p.m. Mr. F. Groves, "Main Roads, Past and Present, and Modern Methods of Construction and Maintenance."

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8.30 p.m. Sir Gilbert Parker, "Lights and Lessons of the War."

Wednesday, April 14...Royal Society of Arts, John-street, Adelphi, W.C., 8 p.m. Mr. T. Thorne Baker, "The Industrial Uses of Radium."

Geological Society, Burlington House, W., 8 p.m. Mr. S. H. Warren, "Further Observations on the late Glacial or Ponder's End Stage of the Lea Valley."

Automobile Engineers, Institution of, at the Institution of Mechanical Engineers, Storey's-gate, S.W., 8 p.m. Mr. F. W. Lanchester, "The Screw Propeller."

Japan Society, 20, Hanover-square, W., 8.30 p.m. Mr. N. Kato, "Eastern Ideas and the Japanese Spirit."

Electrical Engineers, Institution of (Local Section), The University, Birmingham, 7.30 p.m. Mr. J. H. Rider, "The Power Supply of the Central Mining-Rand Mines Group."

Literature, Royal Society of, 20, Hanover-square, W., 5 p.m. Lecture by Dr. W. L. Courtney.

Thursday, April 15...Royal Society of Arts, John-street, Adelphi, W.C., 5 p.m. (Indian Section.) Mr. P. Landon, "Basra and the Shatt-ul-Arab."

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Linnean Society, Burlington House, W., 5 p.m. Mr. C. F. M. Swynnerton, "Experiments and Observations bearing on the Interpretation of Form and Coloration in Plants and Animals."

Royal Institution, Albemarle-street, W., 3 p.m. Professor A. S. Eddington, "Star Colour and its Significance."

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Rev. F. D. Morice, "Paradoxical modifications of Structure in Stinging-Insects and Sawflies."

Optical Society, at the Chemical Society, Burlington House, W., 8 p.m. Colonel J. W. Gifford, "Optical Instruments for Military Purposes."

Electrical Engineers, Institution of, Victoria-embankment, W.C., 8 p.m. Mr. J. H. Rider, "The Power Supply of the Central Mining-Rand Mines Group."

Historical Society, 7, South-square, Gray's Inn, W.C., 5 p.m. Mr. F. A. Kirkpatrick, "The Spanish Municipal Administration in South America, 1500-1800."

Architects, Society of, 28, Bedford-square, W.C., 7.30 p.m. Mr. S. D. Chalmers, "Artificial Lighting in relation to Architectural Effects."

Mining and Metallurgy, Institution of, at the Geological Society, Burlington House, W., 8 p.m.

Friday, April 16...Royal Institution, Albemarle-street, W., 9 p.m. Mr. S. Graham, "The Russian Idea."

Mechanical Engineers, Institution of, Storey's-gate, Westminster, S.W., 8 p.m. Address by the President, Dr. W. C. Unwin.

Saturday, April 17...Royal Institution, Albemarle-street, W., 3 p.m. Colonel A. G. Hadcock, "Modern Artillery." (Lecture I.)

Correction.—A correspondent points out that in the article on "Production of Quinine in Italy" in the *Journal* of March 12th, 1915 (p. 379), in the last paragraph but one, a mistake was made in converting grammes to grains. The paragraph should read: "The average consumption last year, in Italy, of quinine manufactured by the State was 569 grammes (8779·67 grains) per 1,000 of population, as compared with 545 grammes (8409·35 grains) of the previous one."

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FRIDAY, APRIL 16, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, APRIL 21st, 8 p.m. (Ordinary Meeting.) MORETON FREWEN, "The State and the Fisherman." The RIGHT HON. WALTER H. LONG, M.P., LL.D., F.R.S., will preside.

Further particulars of the Society's meetings will be found at the end of this number.

PRESENTATION OF THE ALBERT MEDAL TO SENATOR MARCONI.

At the last meeting of the Council, on Monday afternoon, the 12th inst., Colonel Sir Thomas H. Holdich, R.E., K.C.M.G., K.C.S.I., C.B., D.Sc., Chairman of the Council, on behalf of H.R.H. the Duke of Connaught and Strathearn, K.G., President of the Society, presented the Society's Albert Medal to Senator Guglielmo Marconi, G.C.V.O., LL.D., D.Sc., "for his services in the development and practical application of wireless telegraphy."

In addition to the Chairman, the following members of the Council were present:—Sir George Ranken Askwith, K.C.B., K.C., D.C.L. (Vice-President), Sir Steuart Colvin Bayley, G.C.S.I., C.I.E. (Vice-President), Sir George Birdwood, K.C.I.E., C.S.I., M.D., LL.D. (Vice-President), William Henry Davison, M.A. (Treasurer), Sir Steyning William Edgerley, K.C.V.O., C.I.E., Francis Grant Ogilvie, C.B., LL.D., Sir Westby B. Perceval, K.C.M.G. (Vice-President), Sir Boverton Redwood, Bt., D.Sc., F.R.S.E., Lord Sanderson, G.C.B., K.C.M.G. (Vice-President), John Slater, F.R.I.B.A., Alan A. Campbell Swinton, Carmichael Thomas (Treasurer), and Professor J. M. Thomson, LL.D., F.R.S. (Vice-President).

EXAMINATIONS.

This year for the first time the Examinations are being held twice. The first examination was held from March 22nd to 31st. The second will be held from May 10th to 19th.

As the entries for the May Examinations have been received, the figures for both are given below.

It will be seen that the total number of entries for both Examinations is 32,113. This shows a falling-off of 5,860 as compared with last year, when 37,973 entries were received. The large decrease is no doubt entirely attributable to the conditions prevailing throughout the country owing to the war.

March	May	Total.
Stage I.—Elementary.		
8,649	5,981	14,630
Stage II.—Intermediate.		
4,290	8,120	12,410
Stage III.—Advanced.		
1,488	3,585	5,073
14,427	17,686	32,113

In 1914 the figures were:—Stage I., 17,213; Stage II., 14,425; Stage III., 6,335.

The decrease in the different stages is:—Stage I., 2,583; Stage II., 2,015; Stage III., 1,262; Total, 5,860.

There were 221 Centres for the March Examinations, and there will be 252 for May.

Last year there were 406 Centres.

NORTH LONDON EXHIBITION TRUST.

In 1865 the Committee of the North London Working-classes and Industrial Exhibition (1864) presented to the Society of Arts a sum of £157, the balance of the surplus from that Exhibition, with a view to the annual award of prizes for the best specimens of skilled workmanship exhibited at the Art Workmanship Competitions of the Society of Arts. The Art

Workmanship Competitions were discontinued after 1870, but since that date various prizes have been awarded under this Trust. Prizes were offered to the students of the Artistic Crafts Department of the Northampton Institute, Clerkenwell, in 1903, and have been continued annually to the present time. These have been awarded, for the present year, as follows:—

Senior Section.—Prize of £2 and a Certificate to W. G. Cook, for an Engraved Plate.

Prize of £1 and a Certificate to A. W. Broderick, for an Engraved Plate.

Prizes of 10*s.* each and a Certificate to W. F. Elmore and to W. A. Hill, for Drawings and Specimens of Work.

Junior Section.—Prizes of 10*s.* each and a Certificate to A. Vecchione, for a Cloth Case, and to I. Chambers, for a set of Steel Dies.

The awards have been made on the recommendation of Mr. Alan S. Cole, C.B.

PROCEEDINGS OF THE SOCIETY.

SIXTEENTH ORDINARY MEETING.

Wednesday, April 14th, 1915; Capt. Charles E. S. Phillips, F.R.S.E., in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Best, William Newton, M.Am.S.Mech.E., 11, Broadway, New York City, U.S.A.

Higman, Ormond, M.I.E.E., Electrical Standards Laboratory, Ottawa, Canada.

Jairazbhoy, Cassamally, Warden-road, Bombay, India.

Khan, Sahebzada Abdussamad, C.I.E., Chief Secretary, Rampur State, Rampur, United Provinces, India.

Mellor, Alfred, 152, West Walnut-lane, Germantown, Philadelphia, Pennsylvania, U.S.A.

Ram, Atma, Civil Lines, Ludhiana, Punjab, India.

Rumbough, John B., Enterprise Machine Company, 67-71, North Main-street, Asheville, North Carolina, U.S.A.

Smith, Miss Alice Maude, M.D., Chicago State Hospital, Dunning, Illinois, U.S.A.

Wilder, Gerrit Parmile, c/o Hawaiian Trust Company, Ltd., Honolulu, Hawaii.

Wilder, Leonard H., Ingleside, near McLean, Virginia, U.S.A.

The following candidates were balloted for and duly elected Fellows of the Society:—

Hitchins, Alfred Bishop, 194, Main-street, Binghamton, New York, U.S.A.

Maxwell of Calderwood, Lady (Jane), Glen Owen, Cheltenham.

The paper read was—

THE INDUSTRIAL USES OF RADIUM.

By T. Thorne Baker.

Radium has already passed through three stages in the way in which it has been regarded by the public. In its early days it was looked upon as something of a miracle, which was to revolutionise modern science, prove an endless source of power and energy, and act as a panacea for all human ailments; it was exploited by many quasi-scientific people, and very soon became regarded with something akin to suspicion. Then followed a period of forgetfulness as far as the public was concerned, while a great deal of careful, and apparently rather unproductive, research work took place, till it reached the third stage, when its applications to medical science became seriously recognised.

I want to put before you to-night a paper more suggestive than anything else. There seems little doubt that radium is destined to play an important part in industrial work as well as in medical science, and I hope to be able to give some instances which will indicate some of the possible lines on which radium may be employed in the near future.

A little over a year ago I had the pleasure of describing here some experiments which had been carried out in connection with agriculture; they were only of a preliminary character, but I am glad to say that they led to others making similar experiments, in many cases with very interesting results. It is not too much to say that in the hitherto worthless residues of the radium factories we have one of the most valuable agricultural assets of the country, which, if utilised with discrimination, will give a great impetus to intensive farming. Intensive culture in this country has hung fire, so to speak, because we do not like giving the almost paternal care to the work which is so absolutely essential; radium will, therefore, be particularly welcomed because the stimulus it gives to growth is so pronounced that intensive culture does not then require anything like the trouble ordinarily involved.

The early results obtained in plant and vegetable growing with radio-active soil have been up to the present uncertain, and therefore disappointing. During the last six months experiments carried out in warm laboratory germinators have elucidated many points previously doubtful, and I shall be able to show, as the result of experiments, how these

uncertain results arose, and how the uncertainty can be removed.

We have to remember, first of all, that radium is extracted from various kinds of mineral: where pitch-blende at first was the only source of supply we now depend far more upon carnotite, autunite and other minerals, containing very much less radium, but which are themselves far more abundant. Methods of extraction vary widely, as does their efficiency; and whereas some residues—after all the "available" radium has been extracted—contain 8 to 15 milligrammes of radium to the ton, others contain only 1 or 2 milligrammes per ton. Standardisation as regards "radium content" is thus obviously necessary; but what is of far more importance are the metallic compounds associated with the radium, and of course present in comparatively excessive quantities.

Radium is always associated with uranium in the proportion of about 3·4 parts of the former in 10,000,000 of the latter. In order to show the effect of uranium on vegetable life, I made some tests recently which gave very interesting results. Mustard seeds were sown in soil in test saucers and placed in a germination box. Lot A was watered three times daily with tap water; Lot B with a 1 per cent. solution of pure uranium nitrate, *i.e.*, uranium from which the radium had been extracted. The results were as follows:—

Lot A . . 82 per cent. of the seeds germinated.
Lot B . . 0 per cent. of the seeds germinated.

In other words, the uranium had proved fatal.

The experiment was then repeated, only this time Lot B was watered with a 1 per cent. solution of active uranium nitrate, *i.e.*, uranium nitrate containing the equilibrium amount of radium. The results were as follows:—

Lot A . . 81 per cent. of the seeds germinated.
Lot B . . 56 per cent. of the seeds germinated.

You will thus see that, despite the ordinarily fatal qualities of the uranium, the radium was able to give sufficient vitality to the seeds to enable 56 per cent. of them to germinate.

The importance of these experiments is that they show how necessary it is, if radio-active residues are to be used for agricultural work, that every impurity be known and, if possible, got rid of. A notable instance last year was that of a well-known seed firm, which carried out very numerous tests with radium residues, and got very great variations in the results, rendering the whole of the work somewhat doubtful. I found, on investigation, that the residues came from different sources, some containing copper and uranium, while one of the residues I happened to know contained no radium at all.

The ideal process of production for agricultural work is what is known as the concentration process. The residues, after full extraction on a commercial scale of the radium, are subjected to a method of concentration by which about 90 per cent. of the inert material is discarded; the whole of the radium content is then found in the "concentrates," so that in any case any deleterious matter is reduced to one-tenth of the normal. But it so happens that in this process the heavier matter is discarded, so that a good deal of metallic residue is done away with, and there is very little in the final product but radium contained in silica.

These concentrates are, however, not always available, but it may be taken for granted that the vanadium, uranium, or copper is usually extracted before the "residue" stage; on the other hand, weak radio-active earth supplied from the neighbourhood of radium mines will very probably contain uranium or copper, or both, and will then be unsuitable for obtaining the best results. By fusion with crude caustic soda, or by vigorous boiling with alkaline carbonate, the radium and barium are obtained as insoluble carbonates; these are usually dissolved next in hydrochloric acid, and the radium barium chloride either precipitated as sulphate, or precipitated directly by the addition of sufficient concentrated hydrochloric acid.

It may be emphasised here that, in agricultural work, soluble radium salts in very small quantities completely kill soil organisms, and that the use of too liberal a quantity of insoluble radio-active matter is almost fatal to plant life. I have found that 1 cc. of a 1 : 25,000 solution of pure radium bromide in 10 cc. of culture medium entirely prevents the growth of ordinary soil bacteria.

In agricultural, and, I think, other types of industrial work with impure radium, or radio-active residues, we shall always have to consider two things: (1) The influence of the associated impurities; and (2) which of the rays emitted are responsible for the effect produced.

Radium gives off three types of ray, the α, β, and γ. The α rays are absorbed by a thin sheet of note-paper, the β mostly by a sheet of lead 1 millimetre thick; the γ rays have very great powers of penetration. The β rays are about 100 times as penetrating as α rays, while γ rays

are 10 to 100 times as penetrating as β rays. In order to determine the effect on germination, tests were made in earthenware saucers with mustard seed, the saucers being placed in the electric germinator. This germinator consists of a stout metal or wood box, electrically heated, with glass shelves at different heights, and adequate temperature control. The seeds were subjected to a temperature of about 28° C. for sixteen hours a day, and about 15° C. during the remaining eight hours.

In test A the seeds were sown in ordinary mould, as a control; in test B also ordinary mould was used, but the seeds were watered with radium emanation water, which gives only α rays; in test C the seeds and soil were placed over radium barium chloride, with a sheet of card 1 millimetre thick separating it, so that the β and γ rays were effective; while in test D a sheet of lead 3 millimetres thick was interposed, so that γ rays alone could influence the germination.

The result of the radium emanation water was very marked, as 100 per cent. of the seeds germinated, and the seedlings grew in each case at a uniform rate. In the control test about 90 per cent. of the seeds germinated, but, as is common in these cases, the growth was erratic, about half the seedlings developing normally, the other half being dwarfed by lack of vitality. The α rays of radium, especially when administered in the form of emanation water, have always, in my experience, shown a very pronounced tendency *to increase the vitality of plants.*

Although not much difference is to be detected between the action of the β and γ rays, the β rays seem to produce a more deleterious effect than the γ rays; this is not remarkable when we consider the effect of the X-rays, which are very largely identical with the β rays of radium, in their destructive power on micro-organisms. The β rays are also present in far greater abundance.

The importance of these experiments is that they show that: (*a*) The α rays are largely responsible for increased vitality and quicker germination, hence the great advantage of sowing the seeds in earth prepared with the radio-active matter; (*b*) the emanation is of value to plant growth, and hence, if radio-active matter is laid over the soil, the rain, or the watering, will produce to some extent emanation water which will sink through the earth, reach the roots, and hence be of benefit in accelerating growth.

A convenient form of apparatus for preparing emanation water on a cheap scale is shown in the diagram on the screen. Radio-active material, insoluble in water, and containing 200 or 300 milligrammes to the ton, is packed between fine muslin stretched over wooden frames, and these frames are placed vertically, an inch or two apart, in an enamelled iron tank provided with a tap at the bottom and a well-fitting cover at the top. The tank is filled with water, left for a week or a fortnight, and the water then drawn off as required. By having two such tanks, used on alternate weeks, a continuous supply can be easily obtained.

A more simple apparatus is shown in the photograph on the screen. This is very well suited for laboratory experiments, and is easily put together. A filter flask, of 2 litres capacity, is provided with a delivery tube and tap, the tube projecting to below the surface of the water inside the flask, and a scent-spray bulb is fitted to the tube at the side, so that when pressed the water is driven by air pressure through the delivery tube. At the bottom of the flask is distributed on the largest possible surface 5 grammes of finely divided precipitated radium barium sulphate of about 1 in a million concentration, and the flask is a quarter filled with 500 c.c. of water. For germination tests, milk and cheese experiments, and so on, I have found this a most useful little apparatus, and the emanation experiments above described have all been done with water prepared in it, leaving the water in contact with the radium barium sulphate for one month before use.

I believe that it is legitimate at this Society to make a reference to trade matters, and I should like to refer to a radio-active fertiliser with which I have been experimenting for some three years, known for industrial purposes as "Nirama." This consists of radio-active matter from which practically the whole of the deleterious inorganic matter has been extracted, and after the radium content has been definitely ascertained, it is diluted to a uniform standard with finely sifted and sterilised soil. In order to cope with the demand of the plants, owing to their rapid growth, for more chemical nutrition, nitrogen and phosphoric acid are added in suitable forms, and the effect is in many cases to get anything up to 100 per cent. quicker growth, with noticeable moistness and fullness, as against coarseness and bitterness in taste which often result from hasty or too abundant growth.

Provided uniformity as regards radio-activity be obtained, and sufficient chemical manure be employed to let the plants take the full advantage of the radium stimulus, there is little doubt that this type of fertiliser will be found to play a highly important part in future agricultural chemistry.

We now come to the more practical side of the question, viz., can radio-active compounds be procured on a sufficiently large scale, and at a sufficiently low cost, to render their use possible on an industrial scale?

The present price of pure radium bromide ($RaBr_2.2H_2O$) varies from £18,000 to £25,000 per gramme, or £18 to £25 per milligramme. As the type of residue best suited to agricultural work contains about 2 milligrammes to the ton, and the residue itself is valueless, a ton of material would cost at the outside about £36. As a matter of fact, when buying residues or low-grade ores, the price per milligramme is far smaller, and an average price of £5 per milligramme may be taken as a reasonable basis. Thus £5 would represent the cost of the radium in about 40 tons of soil, and 40 tons spread over or worked into the ground to the depth of from 3 to 5 ins. would obviously cover a very large area of ground. I know of one lump in this country where 2,000 milligrammes in residues are lying idle; this would make 80,000 tons of soil permanently suitable for intensive cultivation, and we can imagine what even this would mean to a small country like England at a time when market gardeners are straining every nerve to increase their yields.

I do not wish to touch on the medical aspect of radium except in two instances, which are, I think, of considerable interest. The first of these is in connection with baths. It is well known that a great number of people went annually to such resorts as Karlsbad and Gastein, where radio-active water is available for baths or for drinking purposes. Very marked results have been obtained in cases of gout, neuritis, rheumatism, and so forth. Where radium water has been administered in this country it has been in the form of emanation water, for the preparation of which large quantities of fairly pure radium salts have been necessary. The emanation water, besides losing its radio-activity in less than six days, emits only α rays—two obvious limitations.

In experimenting with salt furnaces last year, at Carrickfergus, I found that dilute radium salts, *i.e.*, for example, radium barium sulphate containing one part in one million of radium element, was completely soluble in molten salt, and on dissolving a small measured quantity of a radium barium salt in a quarter of a ton of molten sodium chloride subsequent tests showed that homogeneous mixture had taken place. By the process of manufacture in use at Carrickfergus, the molten salt is poured from the furnace into a rotating iron pan; several rakes, or iron pegs, fixed as to position, project into the salt and keep it broken up and also gradually direct it to the periphery of the pan. It is then, in a fine state of division, carried over into an endless band of pans, which empty into graded sifting screens. The fine particles of salt, on being tested both in the α-ray electroscope and by the emanation method, exhibited uniform radio-activity, and on being dissolved in tap water gave an exceedingly finely-divided precipitate of radio-active particles, which easily remain in suspension for some time.

Salt so prepared, and containing approximately 1·375 milligrammes of $RaBr_2.2H_2O$ to the ton, is now being extensively used under the name of "Rabasa" for medical baths, and several officers who have come back from trench life at the front suffering from acute rheumatism have been treated with highly satisfactory results. It is hoped that this salt will, to a large extent, do away with the necessity for visiting Continental bath resorts, but, what is of more importance, it will bring a modern and highly valuable process of therapeutics within the reach of those who hitherto have been unable to go to the expense of radium treatment in Germany.

During the last two years a great deal of active work has been done in the eradication of the fungi attacking what is known as split cod, essentially a Norwegian industry, but one also of growing importance in Great Britain. Cultures I obtained in 1913 from storehouses, drying-sheds, and diseased fish at Christiansund, in the north of Norway, where an immense quantity of cod is dried on the rocks in the sunny months, showed a peculiar behaviour to high-frequency electric currents—apparent inhibition at first, always followed by a marked increase in the rate and profusion of growth. Radio-active salt appears far more effective, and I am hoping this year to be allowed to test its value here with the courtesy and help of the Fishery Board for Scotland.

The effects of radium on bacteria and on fermentation, etc., have already received a considerable amount of attention, but their possible application to industrial bacteriology

is worthy of careful study. The effect of electricity on milk is, of course, well known, although by no means perfectly understood. A thunderstorm, for example, will turn milk sour, presumably by the rapid increase of growth of the acid bacteria it contains. In milk of bad quality as many as 124 million bacteria have been found to the cubic centimetre, or, roughly, 60,000 million to the pint. One bacterium can, by simple fission, become two in twenty minutes, under normal conditions. Under suitable electrical conditions the bacteria would double their numbers in a few minutes. Hence it is not difficult to see that milk not too fresh could be "turned," or become sour, in a very short time when under electrical influence. The α rays of radium consist of positively-charged particles, and their effect may thus be analogous to the positive electricity which is so beneficial to plant life and to many bacteria. Tubes of milk stood in highly concentrated radio-active matter, the β and γ rays penetrating the glass, but in each case there was very little result. If, on the other hand, milk is slowly filtered through a layer of insoluble radio-active matter, and the milk bacteria are brought into contact with the α radiation, a very rapid effect is noticed, the milk clotting within a short time. In other words, radium is able to take the place of the ferment rennet, and may therefore prove of value in the manufacture of cheese. I hope that this reference to the cheese industry may induce others to investigate these possibilities.

The fact that an intermittent current of about 30 to 50 milliamperes passed for ten minutes through milk will cause it sometimes to keep in good condition at 25° C. for three days, is significant of the extraordinary effect of certain types of electrical influence on inhibiting the growth of the lactic acid bacteria, and probably the bacillus coli communis and the other micro-organisms present. Recent preliminary tests have shown the presence of soluble radium to be highly effective in increasing the rate of alcohol production by fermentation, while too much radium again inhibits the growth of the ferment or destroys it.

Radium has, in certain instances, a distinct bactericidal action, and we shall probably find, as its properties become more closely understood, that besides possessing very selective action, stimulating some bacteria and inhibiting the growth of others, it will assist growth when used in minute quantities, and prove fatal when more concentrated. Some tests recently made with a common air staphylococcus, the organism grown in culture media containing

(*a*) 10 per cent. of a 1 : 25,000 radium bromide solution;

(*b*) 10 per cent. of a 1 : 2,500,000 radium bromide solution;

(*c*) the control culture medium;

gave the following results:—

(*a*) No growth after five days at 27° C.

(*b*) Fair growth after five days at 27° C.

(*c*) Normal growth.

A good deal of work will probably be done in the near future in the design and manufacture of radium emanation water apparatus. Ingenious devices are already manufactured by which water is filtered very slowly through a porous block, in the material of which is incorporated radio-active matter of just the necessary strength to emanate it during its passage through. These have also been made in the form of syphons.

Common methods in America are to precipitate the sulphate on asbestos and place the latter in a porous cell, and to mix it with charcoal and form "slabs."

There must be an advance in these things, however, as soon as it is more generally recognised that dilute radio-active matter, very much less expensive, can be used with equal success for the purpose, and I think that the slow progress made in this direction is due to the fact that the medical scientific man usually buys pure radium salts at standard prices for making emanation, and the weaker material remains in the hands of the radium factories, and has not been sufficiently exploited.

Take, for example, some quotations recently made:—

(Practically) pure radium bromide, $RaBr_2 . 2H_2O$, £18,000 per gramme.

Radium barium salts, about 2 milligrammes per kilogramme of radium bromide, £9,000 per gramme.

Slightly less concentrated, containing iron also, but in an insoluble form, £7,500 per gramme.

Residual matter, about 8 milligrammes per ton, £4,000 per gramme.

Now, according to recent experience, the latter material could be employed quite well for preparing emanation water, and it seems a matter for regret that more enterprise is not shown in dealing with this class of material, as radium treatment (for internal administration in the form of water) is at present a luxury, except in hospital work.

The usual strength employed in medical treatment is 1 millicurie to the litre of water. The amount of radium emanation in equilibrium with 1 gramme of radium is called a curie. One-thousandth of this amount, therefore, in the litre of water, is the usual strength, though water containing 6 millicuries per litre has been used in certain cases.*

It is interesting to note here that about $\frac{1}{50}$th or $\frac{1}{25}$th of a millicurie per litre seems the most advantageous to employ for agricultural work.

Radium emanation, as is well known, has a life period of under six days, and falls to half its strength in 3·85 days. The decay is shown in the curve on the screen. In order to obviate this trouble, radium chloride has been successfully administered on the Continent, in the form of tablets, which, of course, retain their entire strength almost indefinitely. The dose used has been about 2·4 by 10^{10} milligrammes, three times a day for several days.

I recently attempted to increase ionisation of mercuric chloride by the introduction into a solution of it of sufficient radium sensibly to increase its electrical conductivity, as one of the existing theories as to the powerful disinfectant powers of mercuric chloride is that the mercury becomes ionised in solution, and is responsible for its bactericidal action. Dr. Andrews very kindly tested these solutions for me at St. Bartholomew's Hospital, and found that the increased ionisation did not increase the action of the mercury. This is of interest incidentally, as it tends to show that the ionisation theory, relating to bactericidal action, on which very divergent views are held, is not correct.

There is little doubt, however, that radio-activity in suitable amount will be utilised in mouth-washes and tooth-powders and pastes, on account of its antiseptic powers when employed at a certain strength. One hears reports sometimes of its powers to cure baldness; but I will not deal with this, as it is not an industry, but something of a fine art!

Another practical use to which radium is being put is the preparation of watch, clock, and compass hands, to render them luminescent in the dark. A year ago such luminous hands were more or less a novelty, but the present war has demonstrated their very real use, and thousands of watches with luminous hands are now being sold. I believe that luminous sign-boards are also in use in Russia, and some time ago there was some agitation to try them in this country. That they will come is very probable.

It is a peculiarity of most of these substances that they must be in the crystalline state to be active. Zinc blende, or sulphide of zinc, in the form of hexagonal crystals, becomes phosphorescent when excited with radium; diamond is similarly excited, also barium platinocyanide, calcium fluoride, and the double sulphate of uranium and potassium.

Crystalline zinc sulphide, usually employed in the preparation of clock and watch hands, is known as Sidot's blende. It occurs in crystalline form in nature, and is not easy to prepare artificially. It can be made, however, by igniting zinc oxide in a current of sulphuretted hydrogen gas, or by heating precipitated zinc sulphide in a stream of the gas. The crystalline structure is not always apparent when prepared in this way, but the desired optical properties are obtained nevertheless.

The luminosity is produced by means of actual scintillations, each α particle emitted by the radium in contact with zinc sulphide producing one scintillation. Professor Wood * has calculated that the duration of luminosity produced by each scintillation does not last more than $\frac{1}{10000}$ of a second. On the other hand, 1 gramme of radium expels $6 \cdot 2 \times 10^{10}$ (over 60,000 million) α particles per second,† so you will see that a very small quantity of radium goes a very long way in producing the luminescence. The β rays of radium produce sustained luminescence of some minutes' duration.

Consequently, luminous paint of permanent luminosity can be prepared commercially by mixing zinc sulphide with radio-active material. It would appear, however, that on account of its relative cheapness, meso-thorium is being largely employed at present. Meso-thorium is produced as a by-product in the incandescent gas-mantle industry. It has a life period of only seven to nine years, as against 2,500 in the case of radium; but, on account of its cheapness, it will probably be more largely manufactured than radium in the future.‡ The result will be that the life of a really good watch or clock will be longer than that of the luminosity of the hands, and this is a point worth consideration by the purchaser who is paying a big price.

One further possible application of radium to industrial work I should like to mention is its use in the preparation of photographic

* C. E. S. Phillips. "Radiography, X-ray Therapeutics and Radium Therapy," R. Knox, p. 843.

* *Phil. Mag* 10, 1905.

† Rutherford. *Phil. Mag.* 10, 1905.

‡ Soddy. "The Chemistry of the Radio Elements," p. 68.

emulsions. The early experimenters with radium used to test the radio-activity of substances by its fogging effects on a photographic plate. Kinoshita showed in 1910* that each α particle of radium acting on a photographic plate rendered one "grain" of silver bromide capable of development, and that the action went on until the whole of the grains within range were affected.

It seems a somewhat bold suggestion, therefore, to mix actual radio-active matter with a photographic emulsion; but I have been able recently to produce emulsions containing a suitable quantity of radium chloride or bromide which yield much denser and more vigorous photographs under test conditions, with the important result that *normal* brilliance in photographs can be obtained by the use of less silver in the emulsion—an economy of far-reaching importance.

In conclusion, I must apologise for the somewhat scrappy and versatile character of this paper, but I have brought it before this Society with two objects: First, to induce, if possible, more enterprise among works' research chemists to test the availability of radium for their own industries; and, second, to point out that in a time of national emergency we have large stores of material, at present lying idle, which could be turned to enormous advantage for agricultural work.

DISCUSSION.

Mr. Martin H. F. Sutton exhibited specimen plants of peas and beans which he had tested with the author's material, "Nirama." In the case of the peas there was but little difference between the controlled and the dressed plants, but, as the audience would see, in the case of the beans there was a very distinct difference. The really interesting point of the test was in the germination. He had brought to the meeting the results of his trials with the material on rape. He had used sand alone, and sand plus "Nirama"; and in the latter case apparently every single seed germinated, and the seedlings came through the sand with the help of "Nirama" three days before they came through the sand alone. From the tests his firm had made, they thought there was certainly something in radio-active material. What it was, or how far it was likely to be useful, they could not at present definitely say. His firm had published a bulletin of what they had done in the matter during the past summer, and anybody interested could obtain a copy by writing to him. What his firm had used during the last summer had been two distinct ores from different sources, and also a slime from the same source as one of the ores came from. During the present year their trials would be considerably more complete.

Professor F. Keeble, F.R.S., desired to emphasise the point that it was greatly to the detriment of science that premature claims should be made for results or for effects, which might in course of time be demonstrated, and which might prove to be of great importance, but which were not yet justified by any results which had been made public. In that respect he was confining his criticism entirely to the suggestions and claims which had been made for radio-activity, or the effects of radium on plant growth. He confessed he was not in a position to explain that very remarkable result which had just been referred to by Mr. Martin Sutton in connection with some of his exhibits, but he would point out that the incubus of explaining that fact did not rest on himself or any other scientist, because no experiment in the strict sense of the word had been made. A certain material, with a name which he had for the moment forgotten, containing, in addition to the substance to be experimented with, a number of unknown chemicals, among others nitrogen compounds and phosphates, had been employed. It was well known that nitrate in certain forms was a great activator as well as a food for the growth of plants; and how much the effect of that precocious growth of the rape was to be ascribed to the radium emanations, and how much was to be ascribed to the unknown nitrogen compounds employed, could not be definitely stated. Judgment must be reserved for the time being as to whether that experiment was destined to contain the germ of a fertile idea. A word of caution should be expressed with regard to the advice given by the author, that all the waste stuff from the radium factories which was lying about this country should be utilised. There was as yet not anything like sufficient evidence to justify any serious horticulturist or agriculturist in spending a penny piece on exploiting radium. A good deal more work would be required to be done before anyone would be in a position to speak confidently as to whether radium emanations produced any effect, and whether that effect was mainly good, or whether it was partly good and partly deleterious. In making that criticism, he had had the privilege of following very closely the experiments which had been carried out by Mr. Sutton, and neither that gentleman nor himself, nor others who saw the experiments, could convince themselves that the effects were more than those which might be ascribed to chance, although there was always a presumption that radium might be doing a certain amount of good. He did not think they even got so far as even considering whether the effects were worth the expenditure of money on the materials. It was important that a warning should be given, because the market had

* *Proceedings* of the Royal Society, A. 83, p. 432.

been flooded by all sorts of stuffs which claimed to be radio-active, and horticulturists and agriculturists were being asked to put their hands into their pockets and pay considerable sums for substances which might or might not be of any use whatsoever.

Mr. B. H. Rolfe supported the views of the last speaker, at any rate in one sense. All who had worked in radium had suffered from violent anticipations which had been made by unauthorised persons as to what could be done. That had been a millstone which had weighed heavily round investigators' necks. With regard to the question of the effect of extraordinarily dilute radium bodies in agriculture, he did not think it had been quite brought out in the paper how very minute those bodies were. For instance, carnotite ore contained, as it was at present, somewhere about 5 or 6 milligrammes of radium to the ton, which had a relation, he might put it, of a second of time to three years. At present somewhere about 85 per cent. of that was taken out, so it could be gathered that the amount left was very minute. That stuff had been used apparently very successfully for agricultural purposes. It had only been done on an experimental scale, but there was one question in connection with it where the last speaker's point came in. There was in that material a certain small residue of vanadium, and vanadium acted to a certain extent as a fixer of the atmospheric nitrogen, and investigators had not yet been able to make up their minds completely as to how much the effect was due to the radium and how much to the other. He thought he might mention some exceedingly interesting experiments which had been carried on at Manchester University by a German student on the germination of barley. That student had found that by keeping his barley under certain conditions, and circulating round it an atmosphere which contained a small quantity of the actual emanation, he got his barley to germinate much more quickly than it would have done otherwise. That certainly suggested that the action of the emanation, if there was enough of it, tended in that direction. That experiment had been checked in a number of ways, and if, unfortunately, that excellent work had been interrupted, still it was a very direct point made in that particular line.

The Chairman (Captain Charles E. S. Phillips, F.R.S.E.) said he would like to point out one small matter which the author had overlooked in giving his long list of the possible applications of radium to commercial matters, and that was a device which was at present in use in the North in connection with the industry of weaving. He had not seen the actual apparatus at work, so he could not describe it in detail, but he believed there was a certain stage in the weaving of thread in which a number of very fine filaments came off in all directions, and very easily attached themselves to parts of the apparatus or the machine through which the thread was passing, owing to the fact that those threads became highly electrified. A very simple and practical way had been devised of overcoming that difficulty, by passing the thread through a tube, upon the inner surface of which was a small quantity of radium, or other radio-active matter. The result was that the air inside the tube became ionised, and the electricity on those fine filaments was at once taken off, and went to earth (the tube itself being connected to the earth); thus the whole difficulty of those filaments flying out in all directions and attaching themselves to various parts of the machinery was completely eliminated. The author had said a good deal about intensive culture, and the great speed at which beans, and possibly other agricultural products, could be grown, but there was one question which he should like to ask, namely, whether the author had investigated the radio-activity of the products at all? For instance, was any of the radium which was in the soil drawn up into the plants themselves? If so, was it quite safe, even supposing the growth of cabbages, and corn, and so on, could be accelerated? With regard to milk, he would remind the author that the results of some careful experiments in that direction had been published before the Röntgen Society, about two years ago, by Professor Duffield. In those experiments the idea had been to try to produce artificially the same conditions, in the neighbourhood of milk, as were associated with thunderstorms. The results were very inconclusive. Mr. Thorne Baker, however, seemed to speak with almost too much confidence as to the results of the clotting of milk by alpha rays, and the increase in the growth of bacteria owing to the conditions associated with thunderstorms. Professor Duffield had tried pumping ionised gas through milk, making sparks in its neighbourhood, and trying to reproduce the conditions of a thunderstorm on a small scale, but with no definite result. He (the speaker) had actually gone so far as to pump radium emanation through milk without producing any sign of clotting. The rate of the development of acid in the milk seemed to be unaffected by the presence of radium emanation. A paper had been recently published dealing with the question of the treatment of certain diseases of the teeth with radium—by means of emanation water. In all these efforts the point that struck one very forcibly was the extreme smallness of the quantities of the material made use of. One might perhaps be allowed to express a certain amount of scepticism over such results where the amount of material used was so extremely small in relation to the large effects which seemed to be produced. If it were possible to increase the growth of a plant, then it seemed reasonable to suppose that by some radio-active means it might be possible to stimulate the growth of other forms of organic cells. He thought there was only one investigator who was of the opinion that the growth of organic cells could be directly stimulated

by means of radio-activity, so that, again, showed the author had taken upon himself a very great responsibility in expressing with such certainty some of the results which were being dealt with by a large number of other men all over the world with a feeling of great doubt. He was sure the author appreciated how difficult it was to make a satisfactory experiment with anything, and the trouble of eliminating the numerous factors which must assuredly enter into matters dealing with the growth of plants, especially under the conditions which had been described. The point was, could the matter be put on a strict laboratory basis? Could the experiments possibly be made in such a way as to eliminate every other influence except the radio-active one? The action of the alpha particles seemed to be one which tended to destroy cells. The idea that the cells should be stimulated to develop and to subdivide, and that the plant growth should be accelerated by means of radium was, of course, nothing more or less than a miracle, because it seemed to be almost impossible to form any basic theory as to why such a result should come about.

THE AUTHOR, in replying to the remarks of Professor Keeble, said he should like to draw attention to one thing which had been very obvious from the results of a very large number of carefully carried out tests, and that was when the radium was mixed with a sterile soil it almost invariably appeared to act better without any nitrogen and phosphorus, or nitrates and phosphates, than with them, except in isolated cases. He was referring to 150 recent germination tests, and in all cases the radium in the necessary strength, or in the strength used, gave apparently the best results. One thing which made him feel more confident than perhaps it would have been wise to be about the effect being due to radium, was that so many of the other effects which were produced were comparable with the effects produced when the crops were electrified. Some analyses made last year of radish grown in radio-active soil showed an increase in the amount of sugar produced of between 30 and 40 per cent., which was very much the same as the increase of sugar obtained in earlier experiments. The reason the material referred to in the paper had been made was not that he desired to push it as a manure or fertiliser, but since he had read his last paper before the Society some fifteen or sixteen months ago, owing to the extraordinary circulation of the *Journal* of the Society, hardly a week went by without one or two people writing from different parts of the world asking where they could obtain radio-active residues; and the point he had tried to emphasise in the paper that night was that if radio-active residues were obtained through a third, fourth, or fifth party, very likely the purchaser would get large quantities of inorganic chemicals with it, which would render entirely impossible the obtaining of accurate results. The point about the preparation was simply that it was standardised as regards its radium content, and that it could always be obtained, if further tests were wanted, in uniform quantities. He thought that, as the tests which had already been carried out showed promise of good results, it was very desirable for larger tests to be instituted, because tests in the open were not always the same as tests in agricultural laboratories. He would like to see forty or fifty acres of ground treated on a large scale. The Chairman had raised the interesting point as to whether plants grown in radio-active soil contained any radium themselves. If the experiments carried out were of any value, it seemed obvious that the best results were obtained with emanation water, or with the alpha rays, and if the results could be obtained with emanation water, which was going to decay in the ordinary time, it was not likely that any products would be left in the plants. He had touched on the milk experiments because he thought it was a matter of some interest, but he quite agreed that not very much could be done, because of the extraordinary variation in milk itself. The question of chief importance was, were the results obtained actually due to radium or to something else which was associated with radium? With regard to the importance of carrying out tests on a much larger scale than they had hitherto been carried out, if whatever was associated with the radium was responsible for the improvement, and not the radium itself, it seemed to him none the less desirable to prosecute the research because that stuff might just as well be used if it gave such good results.

On the motion of the CHAIRMAN a hearty vote of thanks was accorded to the author for his interesting paper.

EMPIRE NOTES.

British and Canadian Trade.—Some valuable suggestions were made by Mr. C. Hamilton Wickes, His Majesty's Trade Commissioner in Canada, in an address recently delivered in the Council Room of the London Chamber of Commerce. on "Trade with the Dominion of Canada and the Empire," on the methods which should be adopted by British manufacturers and merchants if they desire to secure a larger measure of Canadian business. The Canadian market, he said, was one in which the weak points of British methods of trading were strikingly apparent. Canada stood out clearly and distinctly from Australia, South Africa and New Zealand, as in the Canadian market the British manufacturer had to do without his nurse—the export commission house. Secondly, he had to meet the competition of the United States firms, who were better placed, both strategically and geographically. The American manufacturer paid attention to direct marketing and the question

of production in quantities, which, as a rule, was not the custom of British firms. He summarised as the chief obstacles to British trade: (1) the fact that Canadian firms want manufacturers to call and do business with them direct. (2) The existence of United States' standards, which have been accepted by or imposed upon Canadians. (3) The large number of United States magazines and newspapers carrying advertisements of American firms, which find their way into Canada. (4) The fire hazard standard for buildings and fittings, which had to be passed by the Underwriters' Laboratory of Chicago. The Trade Commissioners' office, however, had secured the appointment of a representative of the Laboratory in London, where British makes of building fittings could be inspected and passed. (5) The expense of travelling and the variations of climate in so large a country as Canada. In the matter of organisation, Mr. Wickes suggested that provision should be made for the creation of an Intelligence Department on a large scale. A directory of manufacturers was also needed, and a system should be adopted for the investigation of Imperial sources of supply, particularly in regard to primary products. Firms should be registered as well as companies, and there should be greater co-operation between bankers and manufacturers in this country. Referring to the prospects for the coming season, Mr. Wickes said it was estimated that the wheat crop in Canada would amount to 245,000,000 bushels, and that the financial return would be about 40 per cent. greater than last year. The harvesting of such a crop should tend to relieve the financial situation, but this would not make itself felt until 1916. For the months immediately ahead, caution should be the watchword. Trade might not be more, and would, perhaps, be less in volume than last year, but conditions were moving towards better business. Mr. Wickes is prepared to advise traders at the Commercial Intelligence Branch of the Board of Trade in London during his stay, and he proposes also to visit various provincial centres.

Gold-mining in Western Australia.—The gold production in Western Australia for last year amounted to 1,232,977 ozs., valued at £5,237,353, which is equal to 51 per cent. of the annual gold production of Australia. Speaking in the Western Australian Parliament recently, the Minister of Mines stated that there was a better feeling in the great gold-mining centres, Kalgoorlie and Boulder, than had existed for the past five years. The "Golden Horseshoe" is down to a depth of 2,800 ft. and has struck a rich ore body at that level. The "Golden mile," between Kalgoorlie and Boulder, is still the richest mile of gold-producing country in the world. The State batteries of Western Australia have in fifteen years recovered gold to the value of £4,303,372, almost entirely won from ore sent for crushing by prospectors and small lease owners, with insufficient financial resources to erect their own plants. The Minister estimates that the mining industry pays nearly two and a half million pounds in wages annually.

Railway Progress in New Zealand.—Considerable progress is being made in the construction of the North Auckland Trunk Railway, and a further section from Otamatea to Bickerstaffe will be handed over to the New Zealand Railway Department by the Public Works Department shortly. At present 320 men are employed on the work, and two tunnels are under construction. The station buildings at Bickerstaffe, eighty-three miles seventy chains from Auckland, are practically completed. Ballasting and plate-laying have progressed up to Muddy Creek Bridge, three miles further ahead, and the bridge is completed. Gangs are at work as far north as ninety-two miles sixty-seven chains, many of the men being engaged in tunnel construction. The Mangaturoto tunnel, which is twenty chains in length and eighty-seven miles distant from Auckland, will shortly be pierced, there being only a length of two chains separating the drives. Cuttings are being opened out at a point ninety-one miles forty chains from Auckland, preparatory to commencing work on the Huran tunnel, which will be 297 yards long. There is still another tunnel beyond the Huran, known as the Golden Stairs, and it is anticipated that the earthworks ahead of these tunnels will proceed simultaneously with the completion of the Huran tunnel. The new Parnell tunnel (double track) between Auckland and Newmarket is virtually completed. This tunnel, which will replace the old single-track bore, enabling the latter to be utilised as an approach to the waggon and coach-building shops at Newmarket, is 1,122 ft. long, 25 ft. 9½ ins. wide, and 19 ft. 6 ins. high. With its completion, the working of the heavy traffic between Auckland and Newmarket will be greatly facilitated.

Hydrographic Work in Canada.—The Annual Report of the Department of Naval Service for 1913–14 contains reports on the Survey of Tides and Currents and on the Hydrographical Survey branch, summarising the work accomplished during the year. As regards currents, the most important observations were those in the northern passes of British Columbia, notably at Seymour Narrows, carried out in the interests of the large coast traffic of that region, and also of the international traffic to Alaska. Valuable results were obtained in reference to the tides in Hudson Bay and Strait. From a series of observations at Ashe inlet in the latter, it was found that the tide in Hudson Strait is similar to that in the Bay of Fundy, and that, as the

tidal difference between Ashe inlet and St. John, N.B., are remarkably constant, a satisfactory means is available for computing the tide in the Strait. Progress was also made towards the provision of tide-tables for Nelson and Churchill in Hudson Bay, by establishing the relation between the tide at those places and at western European ports. Thus, the tide at Churchill can be calculated direct from that at Harwich, to which it is remarkably similar, with a constant difference. Of the hydrographic work, that carried out in Hudson Bay by a party under Mr. F. Anderson is of interest. This work was done in the new survey steamer "Acadia," built at Newcastle-on-Tyne, which arrived just in time to be used for the purpose. She was specially strengthened for use in ice, and proved quite successful, though some plates were seriously indented, showing that merchant vessels will incur risks in navigating the bay and straits unless strengthened. Little ice was met with in the straits on the outward voyage, but closely packed winter ice was encountered well on in August, sixty miles off Port Nelson; and on the return voyage heavy ice caused serious trouble on October 22nd, damaging a merchant ship. In view of such dangers from ice, it is held to be important to establish depots of provisions and fuel on the inhospitable shores of the straits. As a result of the surveys carried out, there is now a chart, embracing an area of some forty-five miles off the entrance to Port Nelson. Other parties were at work during the year on the Pacific Coast, on Lakes Superior and Ontario, on the Lower St. Lawrence, and in James Bay. A large amount of sounding had been done and various plans made. In James Bay observations were made of the break-up of the ice in Moose and Rupert Rivers; that in the former being marked by a big flood.

Inoculation against Typhoid.—In view of the importance of the subject of inoculation against typhoid during the war, and its application to general hygienic conditions where masses of men are gathered together in construction and lumber camps, the experience of the Canadian Pacific Railway Company is of more than passing interest. It appears that in their railway construction camps, typhoid is one of the forms of disease most to be guarded against, and that, for this purpose, the company has found the use of the anti-typhoid serum to be of the greatest service. Last year alone 11,722 employees were vaccinated on the western lines, and amongst those only four cases of typhoid developed, one of which proved fatal. Among the men not inoculated, sixty-two cases developed of which nine proved fatal. On the Alberta division eleven cases of fever occurred in a camp situated within the city limits of Calgary, containing thirty-five men who had refused to be vaccinated. After the cases developed they all asked to be treated, with the result that only one death occurred. Before the campaign for inoculation was instituted by the company's doctors, several hundred cases occurred, on an average, annually. The comparative freedom which the employees of the company now enjoy from the disease is cited, and may well be cited, as an evidence of the value of the anti-typhoid serum, which is supplied to the men free.

South Africa and the Indian Question. — The settlement of the status of Indians in South Africa comes at an opportune time, and the Union Act, according to the Secretary of State for the Colonies, has been welcomed by His Majesty's Government as embodying a genuine and sincere attempt to remove those disabilities of the Indian population of the Union which had kept alive a sense of grievance and discontent, not only in South Africa, but in India. The Government of India, it is stated, have expressed their gratification at finding in the recommendations of the Indian Inquiry Commission, to which effect, in conjunction with administrative action, is now to be given by this Act, a very complete and satisfactory attempt to arrive at a final solution of the difficulties that have arisen in South Africa. The Secretary of State further says that His Majesty's Government have learned with pleasure that this Act, coupled with the agreement with Mr. Gandhi, regarding the administrative action to be taken by the Union Government, has been accepted by that gentleman as finally closing the passive resistance struggle which began nearly eight years ago, and they confidently believe that the spirit which has animated both parties to the controversy, and which alone has rendered settlement possible, will continue to make itself felt, and will render easy the solution of any difficulties which may arise in the future. This is specially gratifying, in view of the more sympathetic feeling which is growing up throughout the Empire towards those races in India and elsewhere, living under the British flag, who have so willingly offered, and are now giving, their services to the King-Emperor and to the maintenance of the Empire itself of which they constitute so important a part.

The Progress of Fiji.—Some interesting facts, showing the progress and prospects of Fiji, were given in the address of the Governor to the Legislative Council some time ago, in which he stated that the cost of the Agricultural Department had increased from £665 in 1905 to £6,244 (estimated) in 1914. Referring to a recommendation made in his address in 1912, that planters, who have suitable land and sufficient funds at their disposal, should experiment in the cultivation of limes, he pointed out that the lime industry of Dominica in the West Indies was valued in 1912 at £97,142, and that the area of land under lime cultivation was only

3,300 acres, which gave an approximate return of £30 per acre. Canada, the United States of America, Australia, and New Zealand, he said, afforded ready markets for the sale of limes both ripe and green, lime-juice, citrate of lime, and essential oils, so that the permanent character of the lime industry must commend itself to those agriculturists who desire a safe investment for their capital and could afford to wait four or five years until the first crop could be gathered.

CORRESPONDENCE.

EXTERMINATION OF FLIES AND MOSQUITOES.

With regard to the extermination—or, at all events, the discouragement—of mosquitoes, it may be of interest to state that at Honolulu, some years ago, the experimental growing of a species of *Lemna* (duckweed) was tried on small surfaces of water, with a view to preventing female mosquitoes from gaining access to the water for purposes of depositing. I understand that the experiments were successful in demonstrating the efficacy of the method. The duckweed leaves become so closely matted together on the surface of the water, and the roots beneath it, that it is virtually impossible for any insect to penetrate the skin thus formed. Not many years ago I recollect seeing a mill-dam on the Avon, near Coventry, of large extent, absolutely covered with a species of duckweed. So thick and firm was the skin, that numbers of moorhens were walking about on the surface.

G. Bertram Kershaw.

OBITUARY.

Samuel George Smith, M.A., D.D., LL.D.—The death of Dr. Samuel G. Smith, of St. Paul, U.S.A., took place on March 25th, after a short illness.

Dr. Smith was born at Birmingham in 1852. While he was still a child his parents went to America, his father, who was a Methodist minister, having taken a missionary post in Iowa.

At the age of seventeen Samuel Smith was in charge of the public schools of Jessup, Iowa, and at twenty he was principal of the Albion Academy, Iowa. He afterwards attended Upper Iowa University, finishing his course at Cornell, from which he graduated in 1872. He then entered the Methodist ministry, and was called in 1879 to the pastorate of the First Methodist Church of St. Paul, where he continued until 1888. In that year he founded the People's Church, with which his name has since been closely associated, and for the endowment of which he succeeded in raising a fund of $100,000 in 1918.

Dr. Smith's activities were by no means limited to his church work. He took a deep interest in social, political and moral problems.

In 1889 he was appointed a member of the Board of Charities and Corrections. A year later the University of Minnesota called him to organise a department of sociology and anthropology. He was placed in charge of it, and continued as head of the department, giving lectures and conducting classes until a few months ago. The department has been a leader in its field, and its methods have been copied in numerous universities and colleges.

As a member of a State Commission he made a trip to Europe in 1892 to inspect penal and charitable institutions, and brought back ideas, several of which were incorporated in Minnesota institutions.

He was one of the pioneers also in anti-tuberculosis work in Minnesota, being identified with the various organisations engaged in the fight against the disease.

As a criminologist and champion of penal reform, Dr. Smith was one of the leaders of the nation. He was a member of the National Conference of Charities and Correction, and the National Prison Association, of both of which he had been president. Dr. Smith also was a member of the State Board of Visitors for five years, from 1907 to 1912.

Another subject in which he took a deep interest was eugenics. He was a delegate to the International Eugenics Congress in London in July, 1912, where he made one of the principal addresses.

He made some twenty journeys across the Atlantic and back. His travels took him into all parts of Europe. He spent much time studying in foreign universities and seats of culture, as well as learning the social and economic conditions in foreign lands. He twice was offered the pastorate of the Westminster Chapel in London, the largest and one of the wealthiest Nonconformist churches in London, but refused, preferring to carry on the work he had begun in St. Paul.

Dr. Smith was a prolific writer. Among his works is a book on "Social Pathology," issued in 1911, which is being used as a text-book in schools and colleges all over America. Other books of wide circulation are "The Industrial Conflict," "Religion in the Making," "Democracy and the Church," and "Retribution and other Addresses."

He was elected a Fellow of the Royal Society of Arts last autumn.

NOTES ON BOOKS.

Dew-Ponds. By Edward A. Martin. London: T. Werner Laurie, Ltd. N.d. 6s. net.

In the spring of 1909 Mr. George Hubbard read a paper on "Dew-ponds" before the Society, in which, adopting the old theory of their origin and nature, he recommended their more general use in waterless regions.* This paper was followed by a good deal of discussion,

* See *Journal*, LVII. p. 330.

at first in the columns of the *Journal*, and afterwards in the *Field* and *Nature*. The author of the work under review took part in this discussion, and in a contribution to *Nature* he rather controverted Mr. Hubbard's views on several points, the most important being the question whether the water in the pond, after being heated during a summer day, can ever fall in temperature below the dew-point. Aided by a grant from the Royal Society, Mr. Martin continued and extended the series of experiments on which his views were founded, and the present work is the result of his further investigations.

He not only made a number of observations on existing ponds, but had an experimental pond constructed of the orthodox type, with a layer of straw and other non-conducting material below it. The result of the observations made, and the information collected, was that, in the author's opinion, the surface water would never in warm weather cool down to the dew-point, and that consequently, even when there was abundant dew on the surrounding herbage, none would be deposited in the pond; that the straw, etc., could never be kept dry, and that therefore it soon lost its non-conducting powers, which further were of no value since they did not enable the water to cool down, even if they did cut off the access of heat from the earth; and, finally, that the source from which the upland ponds were filled was fog and mist, aided by rain, and in occasional cases by drainage.

Incidentally, Mr. Martin arrived at the conclusion that there is no justification for attributing any very great age to any existing pond. While admitting that prehistoric man may have used "naturally-puddled pools where four-footed beasts came to quench their thirst," and may have constructed ponds with puddled clay bottoms, he can find no evidence of his having made any existing pond, or of his ever having constructed a scientific straw-bottomed pond at all. All such ponds, he says, if neglected, become useless. Grasses and rushes thrust their roots through the puddle, they cease to be waterproof, dry up, and are overgrown so that nothing but an empty hollow remains.

It is sad to think that the prehistoric dew-pond, which has supplied alike the cattle of our præ-Roman ancestors and the sheep of our contemporary shepherds, is but a charming myth. But so Mr. Martin will have it, and it rather looks as if he were correct.

ESSENTIALS OF ENGLISH SPEECH AND LITERATURE. By Frank H. Vizetelly, Litt.D., LL.D. New York and London: Funk & Wagnalls Company. $1.50 net.

In this volume Dr. Vizetelly gives—to quote his own sub-title—an outline of the origin and growth of the language, with chapters on the influence of the Bible, the value of the dictionary, and the use of the grammar in the study of the English tongue. Nor does this comprehensive description exhaust the scope of the book, for the final chapters deal with phonetics, pronunciation, writing for publication, individuality in writing, and the corruption of speech. It will be obvious at once that such a vast field can only be hurriedly surveyed in the space of 400 pages. Thus, the sketch of English literature is of the slightest: Shakespeare is dismissed in eight pages, Milton in six, while, of course, it is only the Tritons who are mentioned in the text; the minnows must content themselves with having their names and dates recorded in an appendix.

To this criticism the reply, no doubt, would be that there are plenty of histories of English literature, and that this book does not claim to be one of them. Indeed, Dr. Vizetelly specially disavows any pretence to exhaustiveness. His aim—and it is a praiseworthy one—is to enable the student to determine with ease the different periods in the evolution of the language, and to provide him with a succinct guide to the important writers of each period. If the volume succeeds in inducing any of its readers to a serious study of English language and literature, it will have justified the labour which Dr. Vizetelly has clearly spent upon it.

THE MOTOR CYCLIST'S HANDBOOK. By "Phœnix." London: Percival Marshall & Co. 2s. net.

The first edition of this handbook was published in 1911; since then over 17,000 copies have been sold, and now a fourth edition has been called for. It is easy to understand the popularity of this book, for it is extremely practical, is written by one who is a complete master of his subject, contains everything that a motor cyclist wants to know, and nothing that will be useless to him.

Probably no industry is making more rapid strides at the present time than the manufacture of motors. This edition, which is thoroughly up to date, contains therefore a good deal that is fresh. Owing to the growing popularity of the two-stroke engine, considerable additional space has been devoted to the discussion of the two-stroke principle, and a large folding plate has been prepared to illustrate the construction of an engine of this type and the manner in which it works. A new chapter on cycle-cars has also been added.

GENERAL NOTES.

THE PUBLIC TRUSTEE.—The seventh general report of the Public Trustee shows that the business of his department continues to expand. The number of new estates and trusts which have been accepted in 1914 is 1,548, having a value of

£11,623,429, while the Public Trustee has also been informed that he has been appointed to act as executor in wills prepared and executed during the year disclosing an estimated future value of nearly £10,000,000. The total amount of business undertaken since the opening of the office in 1908 is £132,061,159. The financial stability of the department has been well maintained. The fees for 1914 reached a total of £65,374, as against £55,283 for 1913; while the expenses have reached a total of £61,234, as against £49,612 for 1913, providing a surplus of income over expenditure on the year of £4,140. A portion of the increased expenditure for the past year is due to the establishment of a branch in Manchester. It is satisfactory to learn that the staff, who have loyally carried out their onerous duties, have now been appointed members of the established Civil Service. The staff includes 213 male officers; of these not less than 71, or 33 per cent., are at present on active service in various capacities.

Motor-cars in Norway.—Until the outbreak of the war the autocar industry in Norway was limited to the coach work solely, whilst the *chassis* and other mechanism were obtained from foreign makers. The finished cars were principally imported from Germany, France, England, the United States, with a few from Italy and other countries. This trade, however, during the present crisis, is at a very low ebb, and a very small number have been imported since last August. A great impetus to the introduction of the motor vehicle in Norway has been given of late by the improvement of the roads throughout the country. Previous to 1913, the total length of roads practicable for motor traffic in Norway did not exceed 2,953 kilometres (1,831 English miles); their length, at the present time, has greatly increased, and now reaches a length of 4,318 kilometres (2,677 miles). In 1913 the total number of vehicles propelled by motors was only 972, as compared with 1,553 last year, showing an increase of 581, or 60 per cent. on the number of the previous year. The use of the autocar is increasing all over the country, even in the most remote districts, for the conveyance of passengers and goods. In all the principal towns autocars are taking the place of horses. At Christiania alone there are 462 auto-vehicles in use at the present time; of these, 279 are passenger cars, 85 lorries or vans, and 98 motor-cycles.

The Indian Leather Trade.—Before the war the raw hide business of India was, with a few exceptions, in the hands of Germans. In the years 1911, 1912 and 1913 the normal export of hides to Bremen and Hamburg was about 3½ million cow hides annually, and these ports took over 2½ million cow hides in the first six months of 1914. In addition to exports to Bremen and Hamburg, nearly 1½ million hides passed annually from India through Trieste, and to this port the first six months of 1914 brought 1,178,466 hides. In the total these three enemy ports drew from India in three years and a half 11,335,905 cow hides.

Flour-milling Industry in Japan.—H.M. Commercial Attaché at Yokohama reports that the flour-milling industry in Japan has developed remarkably of late years, and the fact that the flour now imported is principally confined to the first grade shows that second-grade goods can now be produced in Japan. The production of wheat flour in Japan in the years 1911, 1912, and 1913 amounted to 25,396,205 yen, 28,827,512 yen, and 32,694,146 yen respectively, or, expressed in British values, to about £2,592,500, £2,942,800, and £3,337,500 respectively. Along with this development of the milling industry, the demand for wheat has been greatly stimulated, and, according to the latest estimate, the annual consumption of wheat is 2,600,000 koku (12,896,000 bushels), of which some 400,000 koku (1,984,000 bushels) is imported, mainly from the United States. The imports of wheat flour for 1911, 1912, and 1913 amounted to 1,702,951 yen, 1,722,140 yen, and 1,780,065 yen respectively, or, expressed in British values, to about £173,800, £175,800, and £181,710 respectively. The export of Japanese wheat flour is not very large, the value for 1913 amounting only to about 3,400 yen (about £347), but a drawback of 70 sen (about 1*s*. 5*d*.) of the import duty of 77 sen (about 1*s*. 7*d*.) per 100 kin (about 132½ lbs.) of wheat being now allowed on the export of wheat flour made from imported material, the exports are thought to be likely to increase.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock :—

April 21.—Moreton Frewen, "The State and the Fisherman." The Right Hon. Walter Hume Long, M.P., LL.D., F.R.S., will preside.

April 28.—A. S. E. Ackermann, B.Sc., Assoc. M.Inst.C.E., "The Utilisation of Solar Energy."

May 5.—Augustus Vernon Harcourt, D.C.L., LL.D., D.Sc., F.R.S., "On the Measurement of the Efficiency of Domestic Fires, and on a Simple and Smokeless Grate."

May 12.—Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry." Sir Robert Abbott Hadfield, D.Sc., F.R.S., will preside.

Additional Lecture.

Thursday afternoon, at 4.30 o'clock :—

May 6.—M. Paul Lambotte, Directeur des Beaux-Arts au Ministère des Sciences et des Arts de Belgique, "Constantin Meunier et les

Sculpteurs Belges de son Temps." LORD SANDERSON, G.C.B., K.C.M.G., will preside.

INDIAN SECTION.

Thursday afternoon:—

MAY 13, at 4.30 p.m.—SIR CHARLES H. ARMSTRONG, late Chairman, Bombay Chamber of Commerce, "Indian Trade and the War."

COLONIAL SECTION.

Tuesday afternoon, at 4.30 o'clock:—

MAY 4.—S. CHAS. PHILLIPS, M.S.C.I., "The Empire's Resources in Paper-making Materials." The HON. SIR GEORGE H. PERLEY, K.C.M.G., Acting High Commissioner for Canada, will preside.

Date to be hereafter announced:—

C. H. SHERRILL, "Ancient Stained Glass."

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

DAVID SOMMERVILLE, B.A., M.D., M.R.C.P., D.P.H., Assistant Professor of Hygiene and Public Health, University of London, King's College, "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

Syllabus.

Chemical Constitution of Foodstuffs—Proteins—Carbohydrates — Fats — Inorganic Substances—Colloids and Crystalloids—Metabolism—Enzymic Action in the Alimentary Canal.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 19...Victoria Institute, Central Hall, Westminster, S.W., 4.30 p.m. Rev. Professor J. H Moulton, "The Zoroastrian Doctrine of a Future Life."

Brewing, Institute of (London Section), Imperial Hotel, Russell-square, W.C., 8 p.m. Mr. P. Dan, "Advertising as applied to the Brewing Industry."

Electrical Engineers, Institution of (Local Section), Mining Institute, Newcastle, 7.30 p.m. Mr. V. H. Mackinney, "Illumination."

Surveyors' Institution, 12, Great George-street, S.W., 8 p.m. (Junior Meeting.) Mr. H. J. Smith, "Trade Claims in Compensation."

British Architects, Royal Institute of, 9, Conduit-street, W., 8 p.m. Mr. S. Owen, "The Design and Construction of Buildings for Industrial Purposes."

East India Association, Caxton Hall, Westminster, S.W., 4 p.m. Mr. H. Marsh, "Indirect Benefits of Irrigation not generally recognised."

TUESDAY, APRIL 20...Statistical Society, 9, Adelphi-terrace, W.C., 5 p.m. Sir E. Brabrooke, "The Progress of Friendly Societies and other Provident Institutions during the ten years 1904–1914."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. B. Fletcher, "The War on Rheims." (Lecture II.)

Photographic Society, 35, Russell-square, W.C., 8 p.m. Captain O. Wheeler, "Some New Telephotographic Appliances—with Examples."

Engineers and Shipbuilders in Scotland, Institution of, 39, Elmbank-crescent, Glasgow, 8 p.m.

Roentgen Society, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 8.15 p.m. 1. Dr. N. S. Finzi, "Late Radium and X-Ray Burns." 2. Mr. F. H. Glew, "A New Alpha Ray Effect." 3. Mr. A. O. Forder will exhibit a New Plate Holder.

WEDNESDAY, APRIL 21...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. M. Frewen, "The State and the Fisherman."

Meteorological Society, at the Institution of Civil Engineers, Great George-street, S.W., 7.30 p.m. 1. Mr. H. H. Clayton, "A Study of the Moving Waves of Weather in South America." 2. Mr. E. H. Chapman, "The Correlation between changes in Barometric Height at Stations in the British Isles."

THURSDAY, APRIL 22...Royal Society, Burlington House, W., 4.30 p.m.

Linnean Society, Burlington House, W., 8 p.m.

Chemical Society, Burlington House, W., 8.30 p.m. 1. Messrs. G. T. Morgan and J. W. Porter, "The constitution of internal diazo-oxides (diazophenols)." 2. Mr. N. V. Sidgwick, "A method for distinguishing tautomeric from polymorphic substances." 3. Mr. S. U. Pickering, "Metallo-compounds in solution." 4. Messrs. G. Senter and H. D. K. Drew, "Studies on the Walden Inversion. Part I.—The influence of the solvent on the sign of the product in the conversion of phenylchloroacetic acid to phenylaminoacetic acid." 5. Mr. A. J. Allmand, "The energy distribution in the radiation from the Uviol-glass lamp." 6. Mr. E Newbery, "Electromotive forces in alcohol. Part VI.—Absolute potentials by the capillary electrometer." 7. Mr. J. E. Purvis, (*a*) "The absorption spectra of the vapours and solutions of anisol, phenetol, and various derivatives"; (*b*) "The absorption spectra of the isomerides of ammonium d-*a*-bromo-camphor *β*-sulphonate." 8. Messrs. A. McKenzie and S. T. Widdows, "The racemisation of phenyl-*p*-tolylacetic acid."

Royal Institution, Albemarle-street, W., 3 p.m. Professor A. S. Eddington, "The Stellar System in Motion." (Lecture II.)

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mr. E. S. Bruce, "The Aeroplane and its Use in War."

Concrete Institute, 293, Vauxhall Bridge-road, S.W., 7.30 p.m. Mr. F. E. Wentworth-Shields, "The Stability of Quay Walls on Earth Foundations."

FRIDAY, APRIL 23...Royal Institution, Albemarle-street, W., 9 p.m. Major P. S. Leban, "Military Hygiene at the War."

Physical Society, Imperial College of Science, South Kensington, S.W., 5 p.m. 1. Professor W. B. Morton and Miss M. Darragh, "On the Theories of Voigt and Everett regarding the Origin of Combination Tones." 2. Miss M. Saltmarsh, "Experiments on Condensation Nuclei produced in Gases by Ultra-Violet Light." 3. Mr. S. Butterworth, "On the Self-induction of Solenoids of Appreciable Winding Depth."

Mechanical Engineers, Institution of, Storey's-gate, Westminster, S.W., 8 p.m.

SATURDAY, APRIL 24...Royal Institution, Albemarle-street, W., 3 p.m. Lieut.-Colonel A. G. Hadcock, "Modern Artillery." (Lecture II.)

Journal of the Royal Society of Arts.

No. 3,257. VOL. LXIII.

FRIDAY, APRIL 23, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICE.

NEXT WEEK.

MONDAY, APRIL 26th, 8 p.m. (Cantor Lecture.) DAVID SOMMERVILLE, B.A., M.Sc., M.D., M.R.C.P., D.P.H., Assistant Professor of Hygiene and Public Health, University of London, King's College, "Foodstuffs." (Lecture I.)

WEDNESDAY, APRIL 28th, 8 p.m. (Ordinary Meeting.) A. S. E. ACKERMANN, B.Sc. (Engineering), Assoc.M.Inst. C.E., "The Utilisation of Solar Energy." CHARLES VERNON BOYS, F.R.S., will preside.

Further particulars of the Society's meetings will be found at the end of this number.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

A meeting of the Indian Section was held on Thursday, April 15th, 1915; The RIGHT HON. EARL CURZON OF KEDLESTON, G.C.S.I., G.C.I.E., in the chair.

THE CHAIRMAN said it was the custom of those presiding at the Society's meetings to say a few introductory words about the reader of the paper, but such words on his part that afternoon need not be of an introductory character, as Mr. Perceval Landon needed no introduction to any person in the room. Mr. Landon had long been known to all who were interested in the East as a writer of exceptional ability on Eastern and other questions, and he was an authority second to none on the geography and politics of what was commonly called the Middle East. When he (the Chairman) was in India he had the good fortune to be able to allow Mr. Landon to go with the expedition to Tibet. The result was, as all knew, the best book which was in existence upon that expedition and upon that country in modern times. Mr. Landon also wrote a very admirable book upon India itself; and with regard to the countries which he was going to describe that afternoon Mr. Landon himself was a personal visitor to them in the years 1908 and 1912, so that he would speak with that knowledge which personal experience alone could give. Lastly, Mr. Landon was the master of a very vivid and picturesque style, and it might be taken as certain that it would be true of his paper that afternoon—what was not true of all papers—that it would be vastly more interesting than the slides by which it was illustrated.

The paper read was—

BASRA AND THE SHATT-UL-ARAB.

By PERCEVAL LANDON.

I.

There is at least one advantage in taking the town of Basra and the Shatt-ul-Arab as the subject of a paper. It is impossible to detain an audience long with the topic that seems sometimes to possess a fascination for lecturers—the antiquities of the place. Although the Shatt-ul-Arab is within a short distance of the centre and cradle of the earliest developed civilisation of the world, it has no ancient history at all. As a glance at the map will show, in the third millennium before Christ the kingdom of Sumer came down to the Gulf; the two great seaports were Eridu and Ur. That these towns were actually on the sea is clear from a record of about the year 2350 B.C., in which the scribe of Dun-gi, Lord of Ur, notes that his master cared much for Eridu, "which is on the shore of the sea." Four centuries later the great law compiler Khammurabi, King of Babylon, issued orders that troops should be embarked on ships at Ur. The coast-line of the Persian Gulf extended in those days a very long distance to the north-west and north of the present shore. It is indicated on the map by a dotted line.

Before going on, it may be of interest to recall that Abraham left Ur of the Chaldees on his epoch-making journey through Haran to the

Land of Canaan at almost exactly the time at which these orders of Khammurabi were issued. We are not usually disposed to regard Abraham as a longshoreman, but there can be no question that the pastoral life must have been entirely new to the greatest of all patriarchs. When, with his father Terah, he left Ur on a journey that was destined to leave an indelible result upon the world's history, the bleating of sheep and the lowing of kine were alike unknown to him. He had been accustomed to the bustling life of a primitive seaport, the smell of tar and seaweed, and the large talk of sailors.

In his time the site on which Basra now stands was covered by the waters of the Persian Gulf. But it can only have been just covered, and, before turning to later days, it is worth remembering that the account of the creation of the world, as we find it in the first chapter of Genesis, was originally compiled by a scribe of the land of Sumer who was manifestly indebted for his relation of the workings of the Creator to the actual process continually going on eastwards under his very eyes. Little by little the currents of the Euphrates, which of course was then entirely unconnected with the Tigris, were confined in their channels and the dry land appeared. It is, perhaps, not pressing the theory too far if it is suggested that the subsequent story of the growth of grass and of the date palm—and surely we may so interpret the phrase, "the fruit tree yielding fruit after his kind whose seed is in itself"—describes with exactness the gradual coming of vegetable life upon the shores of the Shatt-ul-Arab as they slowly arose from the waters of the Gulf.

II.

So far as we know, the town of Basra was founded by the Caliph Omar about the year A.D. 636. Its rise must have been rapid, as two hundred years later it was the seat of the Christian bishopric of the Persian Gulf. As the seaport of Baghdad it soon became famous, as is proved by the Arab Odyssey, better known to us as the "Voyages of Sindbad the Sailor." The city from which this hardy traveller made his famous departures was not exactly on the site of the present town. Old Basra was placed twelve miles south-west of the European or riverine quarter of Basra to-day, and therefore seven or eight miles south-west of the older quarters of the present town. This earlier Basra was in communication with the Gulf by a canal linking it with the inlets now known as the Khor Zobeir and the Khor Abdalla, and it was through this channel that merchandise was brought in lighters to and from Basra

It is only within living memory that a stretch of mere treacherous swamp has been reclaimed along the bank of the Shatt-ul-Arab, and the European quarter of modern Basra built on piles upon it. It is not uncommon to find Basra referred to as the Venice of Mesopotamia. I am afraid, however, that, as I shall show you in a few moments, the fact that the two towns are built upon piles is the only resemblance between them, and that is not a resemblance that leaps to the eyes.

The importance of Basra lies in the fact that it occupies the nearest site to the open sea which is capable at once of supporting the roadways and houses of a large and populous town on land, and of admitting ocean-going ships to its quays. Calcutta is a parallel. The reclaimed river-bank, upon which is the substantial British consulate and the quays and warehouses of Messrs. Lynch and other merchants, is almost the only part of Basra that demands political attention at this moment. But Basra is more than the river-bank. The place has up to the present suffered from what are probably the two worst disadvantages that can handicap any Eastern town. Its position as a clearing-house and distributing centre—which almost inevitably attracts the dregs of humanity —and the fact that it has been for centuries subject to Turkish rule, will explain at least to this audience the unattractive population and administrative chaos that have been observed by visitors to the town. Possibly there is not a worse governed city in Asia. The Arab has— well, has never been encouraged to develop the art of municipal government. The Turk knew himself to be an intruder in the place. He knew the precariousness of his tenure, and with characteristic Ottoman energy every official determined to make the most of a fleeting opportunity. If I may, I will tell you three stories to show the way in which the responsibilities of government were until lately interpreted in this outpost of the Turkish Empire. There was a Vali of Basra who made the up-to-date proposal that an electric tramway should be constructed along the bank of the Ashar Creek, which extends from the old town to the river. In anticipation of this boon he went so far as to collect much blackmail, partly from the owners of houses which might be benefited, partly from the owners of houses which might be seriously interfered with if the line took a certain course, over which he had, he said, much control. The tramway has not yet been made.

On another occasion the British consul at Basra received repeated complaints from the Vali that a buoy at the mouth of the Shatt-ul-Arab had become misplaced. The consul at once took action, and after some trouble secured the promise of the assistance of H.M.S. "Palinurus" to re-survey the place and replace it. At once the Vali refused to give his consent that the buoy should be touched. I do not know, but I suppose that the buoy was surreptitiously replaced in its right position, but nothing more was heard of it.

There was once a customs official at Basra who demanded dues payable, as he asserted, upon the delivery of a parcel at Bahrein. He still went on claiming them after the question had been referred eighteen times to Constantinople, and eighteen times they had been admitted by the Turkish authorities to be irrecoverable.

Such has been the atmosphere in which Basra has still succeeded in becoming one of the most promising seaports in the Middle East, and that it is destined to be yet more important we may read between the lines of Lord Hardinge's recent speech at Basra, in which he said that the people might look forward in the future to a more benign administration. The fact is, that Basra is geographically and commercially the inevitable centre of the Gulf market.

III.

It has already been said that the site of Basra is due to the fact that it is the lowest stable position at which sea-going ships can unload their cargo. Its importance is also due to the self-evident fact that the shortest line

and the line of least resistance in tracing a course between East and West, between East and Middle East, runs up the Persian Gulf and takes to the land among these alluvial flats.

The early fame of Basra may be suggested by a reference to the voyage of an Englishman, Mr. John Eldred, at the end of the sixteenth century. He was a merchant adventurer, and collected his cargo during the six months that he spent in Basra. On March 26th, 1588, having successfully evaded the naval activity of King Philip of Spain, he arrived home "in the 'Hercules of London,' which was the richest ship of English merchants goods that ever was knowen to come into this realme." As a specimen of the great value of these Eastern cargoes, it is worth while perhaps to give an idea as to how it was transported, and of what it consisted. Eldred chartered a flotilla of seventy barges to take his treasures up the river to Baghdad. To carry it thence across the desert of Aleppo he required 4,000 camels. It consisted of the following things—and I hope that this Society will forgive me if I spend two minutes in reminding them of the wealth of the East by the simple means of reading aloud a Manifest, which, in addition, for sheer music of words is hardly to be surpassed in the English language; and the spices give a pleasant smell between the lines.

"Spikenard from Zindi and Lahore; Cloves from Maluco, Tarenate and Amboina, by way of Java; Nutmegs from Banda; Sinnamon from Seilan, and Wild Sandals from Cochin. Verzini was there from St. Thomas; Quicksilver and Rock Alum from China; Ginger from Dabul, Sorat, Mordas and from Mecca; Coral of Levant from Malabar. Galls had been collected from Cambaia and Bengal; White Sucket from Zindi; Corcunia and Zedoari from divers places in India; Requitria and Myrrh from Arabia Felix; Sal Armoniacke, Costo dolce and Indico from Zindi and Cambaia. Brimeo, which is near to China, contributed Camphor; Borax and Asa Fetida were wrung from Lahore; Seragni, Opoponax and Tutia were the offerings of Persia; Storax calamita from Aneda and Canemari, within Karamania; Bengal sent Wax; Cagiers from Malabar and Maldiva. Rufia to die withal was packed at Chalangi; Chopra at Cochin; Demmar was brought from Sciacca and Blinton; Lac from Pegu and Balagvate; Bdellium—how the Bible rings in this great list!—from Arabia Felix and from Mecca. From Basra itself came Chomin, Tamarinds and Safran; from Sokotra, Aloes, Incense and Dragons' blood; Diu served up its coarse bales of Terebinthe, all for the delight and luxury of England. Masticke from Sio; Opium from Pugia and Cambaia; Ambrachan and Lapis Lazuli, Orpiment, Galbanum, and Chochenillo, Manna from Mecca, and Scamonea. Nor did Eldred forget Galangae, Melleghete and Saracolla with many other spices, of which the very names smell like a garden of herbs; and that the maidens of London should have their sweetmeat, Pistaches Dates and Muske of Tartary."

IV.

We have seen that Basra was an important market at the end of the sixteenth century. It must not be supposed, however, that it lay directly upon any one of the old mainland routes between East and West. These routes ran almost inevitably to the north and east to Basra. Until about the date of John Eldred no one dreamed of going to China or to India except by the road which passed through Tabriz. According to his choice a man might leave Constantinople north east by the Crimean route or east by the Erzerum track. Both paths met at Tabriz. Thence one road struck due east through northern Persia to Bokhara and Samarkand and on to the territory of the Great Khan. The other, turning sharply to the south, skirted the Persian desert, touched at Kashan and Yezd, and reached the sea near Hormuz on the Persian Gulf.

Yet some adventurous souls made for Basra. It is a matter of some doubt whether on their second journey the Polos did or did not descend the Tigris and reach Basra, but it was not the usual route. Probably in those days it was easier to obtain protection at a price from a land chieftain than to secure immunity from the pirates who swarmed at sea. After the Polos Friar Odoric turned aside from the main road, about 1320, and paid a visit to the Shatt-ul-Arab. What struck him most was that the women were unkempt and barefooted, while the men were well dressed. Both sexes lived chiefly upon dates. Marino Sanuto, a little before that time, had noted that the best quality of spices were already being exported to Europe through the Shatt-ul-Arab, while the heavier and commoner spices went round by Aden and the Red Sea. Schiltberger adds little to our knowledge of ancient Basra. We may now turn the page on the older history of the town.

V.

One may approach the Shatt-ul-Arab to-day from three directions—from the Persian Gulf,

from the Tigris, and from the Karun. The date is not far distant when there will be a fourth route along the line of the Euphrates. I mean the Baghdad Railway. In the sixteenth century Basra was a clearing-house of spice. To-day it is a carfax of what may become the most important highways between the east and the west. Indeed, it is hardly too much to call it the solar plexus of the old world. I do not forget the Suez Canal. But what I should like to lay stress upon is the fact that, the Suez Canal being now, and as I hope for good, under the control of the more civilised Powers of Europe, no mistake must be made by leaving open to those who have elected to become our enemies a postern gate—a postern gate which may in time rival in importance the great wet doorway that Ferdinand de Lesseps broke open between Europe and the East. Before considering its importance to ourselves, I should like to give some idea of the existing roads to Basra. I have said that they are three, with the probability of a fourth. But there are others. Besides the Mohammera-Khoramabad track, there are trans-Arabian desert roads which are not as unimportant as might be gleaned from an inspection of maps, geography primers, and Blue-books. The trans-Arabian route is, perhaps, destined to become a railed highway before most of us die.

May I say here that one of the most serious losses that we have sustained during this war has been the death of Captain W. H. Shakespear, whose daring work in Central Arabia has, perhaps intentionally, been fully appreciated by but few. More nearly than any other official he was the Richard Burton of our day, and his death at the very moment when the historic feud in Arabia between Ibn Rashid and Ibn Saud seems to be drawing to its close deserves far more than this passing reference.

VI.

First I will take the approach to the Shatt-ul-Arab by the Persian Gulf. I should like to say something of which it is scarcely necessary to remind this audience. The present monopoly which we possess upon its waters and on its shores—a monopoly not so much of material benefit as of hard work—has been due in a large manner to Lord Curzon. Throughout the early and more hazardous years of the efforts of Prussia to intrude itself into the Gulf, the responsibility for action and insistence lay with him as Viceroy of India, and that we remain therein with our rights and our responsibilities intact is due more to him than to any other living Englishman.

I do not want to repeat here the story of Berlin's persistent attempts to create the simulacrum of German interests in and near the Gulf. They have been well summarised recently by the *Times*; and I can recommend no more serious reading to those who appreciate the importance of our work in Mesopotamia than certain pages in the twenty-ninth part of the *Times* "History of the War."

To these persistent efforts Berlin devoted its subtlest methods of intrigue. By the appointment of consular representatives who did not represent as many souls as would fill one side of a London omnibus; by subsidies and by bribes; by representations to Turkey—which were of the same nature as those which in November of last year induced that unfortunate country to take part in the present war; by attempts to tamper with the loyalty of Sheik Mubarak of Koweit; by sheer "maintenance" of Ibn Rashid of Hail; in short, by every conceivable means of thrust and bluster Prussia has attempted to gain a foothold here.

On the other hand, our own predominance in the Gulf has been secured by eternal watchfulness, a display at times of naval strength, and recently by the addition of one more to the many shades of political understanding that our large Empire includes. The term "special relations" has been applied to our Imperial reciprocity with the chieftainships of Koweit and Mohammera; and, vague as it appears, there is perhaps no single asset—except our command of the sea—which will be more useful to us at this important juncture than the long-standing—nay, the almost traditional—friendship that exists to-day between the Government of India, between the naval forces in the Gulf—between, indeed, any travelling Englishman and the venerable Sheiks Mubarak of Koweit and Khazal of Mohammera.

But our claim is deeper than this. It lies in the fact that for a century we have done the work of the Gulf. We have cleared it of pirates; we have sounded and surveyed it; we have charted, buoyed, and lighted it; we have opened it to the commerce of the world; and there is not a peaceful keel in the wide seas that might not have furrowed its waters in tranquillity without tax or due. We interfere with none, so long as legitimate commerce is kept distinct from political hostility. But we are the stewards of this great highway, and while all the world may use it, no one but ourselves

shall have the right or the responsibility of policing it.

The gun-running in the Gulf, which is now at an end, was centred in Muskat.

[I am throwing these pictures on the screen, not because they will present much that is new to this audience, but because I think it necessary that, if the facts of Southern Mesopotamia are to be well understood, we should, so far as possible, forget the atmosphere of London, even of the Adelphi, and live for the moment, as far as light and darkness can help us to do so, in the external surroundings of the Gulf, the river, and the plains.]

We may abuse the gun-runners, but we must remember the temptation that was offered to them. At any gunsmith's shop in the little suburb of Matra—and the shops were of ominous frequency—you could get a serviceable rifle for £3 10*s*. Now, if you can get that rifle to the Afghan frontier you can sell it for £30. This is no time to consider the incidental effects of this war, but one fact at least is certain, and that is that the turbulent Pathans inside the Durand line will in future have to look elsewhere than to Muskat for their weapons.

Of the other towns in the Gulf it will be sufficient to show you their unvarying external character by a photograph of one of them, Lingah. There is a great similarity between them, though in journeying up one is in turn confronted by the sullen antagonism of Debai, the long vanished glories of Hormuz, the watchful friendliness of Lingah; Bahrein, with its mysterious tombs, where the pearls come from, and where the only fresh water is obtained from the springs at Khor Fasht and Buhir which bubble up through the salt waves of the Gulf. Bahrein is a kind of Monte Carlo of the Gulf. Fortunes are quickly won and lost at pearling, and the visitor realises the high standard of living even before he lands, for he will be asked seven rupees—nearly ten shillings—for the trip in a native boat between the ship and the beach. On the opposite shore to Bahrein, Bushire is the terminus of the road from Isfahan through Shiraz to the Gulf, a road which the raids of the Kashgais and others have nearly closed to merchandise for several seasons.

Koweit, at the head of the Gulf, owes its importance to the fact that it offers the only possible site for an enclosed harbour, and at Kathama, a hamlet at the extreme western end, the Germans hoped to station the terminus of the Baghdad Railway. Not the least of the settlements due to this war will possibly be the abandonment of Koweit for this purpose. A large amount of costly dredging would be necessary before ocean-going liners could approach even Ras-ul-Arz at the south-eastern horn of the bay of Koweit, where the water is deepest. The dredging of the mouth of the Shatt-ul-Arab, which at present admits only steamers drawing 17 ft. of water, though a laborious and continuous task, would be a better plan, especially as the construction of the line from Mohammera to Khoramabad will one day double the importance of the navigation of the Shatt-ul-Arab. You cannot, of course, connect Mohammera directly with Koweit.

VII.

Leaving the friendly shores of Sheik Mubarak, we soon reach through tortuous under-water channels the mouth of the Shatt-ul-Arab. On the left is Fao, which, you will remember, was taken by us without much resistance on November 6th last. It is a place of which the importance lies at present in the fact that it is the landing-place of the submarine cable to India. Just as Lingah may stand for most Gulf ports, Fao may be taken as a sample of the kind of settlement that here and there breaks the continual line of Shatt-ul-Arabian date palms. These palms, which make of the Shatt-ul-Arab an important producing district even apart from its value as a clearing-house, for the most part grow on both sides of the river to a distance varying between one and four miles. The eastern shore, that is to say, that on the right as one goes up, is the bank of Abadan Island, where the fringe of palms is, however, not continuous, and after a journey of about thirty miles the buildings of the refinery of the Anglo-Persian Oil Company are seen, breaking the flat monotony of the horizon. This is the terminus of the famous oil pipe-line which leads the precious black liquid down from the fields at Maidan-i-Naftun, 140 miles away. To that I shall refer later.

A few miles further up the River Karun comes in from the east by a channel known as Hafarieh, or "the excavated place." It may, indeed, be an artificial construction, as the name implies, though it is difficult to imagine why this enormous and unnecessary cost should have been undertaken by anyone. Alexander the Great, who is sometimes credited with the work, was certainly not fool enough to waste months and men on such a work when the Bahmishir was navigable. Mohammera, at the junction of the two rivers, is of course on Persian territory. It will probably leap into importance as the terminus of the railway through Khoramabad,

which will one day communicate, through Hamadan and Kasvin, with the European railway system.

There is one thing I should like to say of Mohammera. A most significant contrast was a few years ago to be seen here. There are two warehouses and distributing centres for goods. One is that of Messrs. Lynch, which, large as it is, was on the day of my visit piled to the roof. The other is the roofless compound of the Germans. This was not merely entirely empty of goods, but was overgrown with weeds and nettles to a height of 3 or 4 ft., except around the broken gateway, where the daily deposit of much of the town's refuse checked the vegetation. Yet it is on the strength of that compound as much as anything else that the Germans dared claim commercial interests on the Karun.

Twenty-two miles up the Shatt-ul-Arab lies Basra. The interminable lines of date palm are broken on the right at Fahlie, where is the palace of Sheik Khazal of Mohammera. There is a pretty little custom observed here. Once upon a time the Sheik was able to render a British-India boat a service against some river pirates. From that day no British-India boat steams up or down this stretch of the river without firing a gun of grateful memory opposite the large and somewhat Italian-looking palace of the Sheik.

VIII.

Basra is a generic term for the old town four or five miles inland, for the deserted ruins eight miles further to the south-west, and for the modern quarter near the river. The most striking view of the place is that along the bank of the Ashar Creek, where the occupation of the place was proclaimed on November 23rd last by Sir Percy Cox and General Barrett. I do not need in this company to expatiate upon the great and notable service that Sir Percy Cox has rendered in the Gulf.

As will be seen, Basra is not a place of great architectural dignity. The Consulate is the only building of importance, an imposing square structure deeply verandahed and approached by a double flight of stairs. The bank of the Ashar Creek is lined with hotels and merchants' houses. It enjoys no reputation for unusual propriety. The bazaar is not very different from any other of the smaller Oriental bazaars. One may buy there ghi and grindstones, dates and dal, sweets and shampooing stones from Bahrein, cotton goods, coffee, red sugar, tobacco, and fish. You may choose also from an indiscriminate medley of cheap German and English hardware. The most remarkable building in the native quarters is the Minaret Bashayyan, which presides in a suit of brand-new blue tiles over a two-hundred-year-old mosque. Otherwise, date groves intersected by creeks and channels form the only feature of inland Basra.

Four or five miles higher up the Shatt-ul-Arab is Magil, the site of the old East India Company's post, now used as a military camp. At Magil the Euphrates falls into the Tigris. This is a fact which has only recently been known, and it has become known through the surveys conducted by Sir William Willcocks. I am sure that you will let me express the deep gratitude which everyone who has had any connection whatever with Mesopotamia must feel towards Sir William Willcocks. We may or may not agree with his identifications of the site of the Garden of Eden, but his activities in this district have not only drawn the attention of the world to the vast and wasted industrial opportunities of Mesopotamia, but have provided a foundation upon which all recent work in the district has been based, whether it be concerned with irrigation, railway construction, navigation, archæology, ethnology, or politics.

Sir William was the man who discovered that every atlas in the world was wrong, and that the Euphrates does not flow into the Tigris at Kurna. That passage is now a stagnant marsh. Magil is the actual point of junction, and was a base for much of the German railway material.

Beyond Kurna the groves of date palms cease for a time, and a flat and dreary expanse stretches away on both sides of the river. I shall take the liberty of quoting a short description written during the expedition to Mohammera of 1857 and kindly put at my disposal by Sir George Birdwood. It is as true to this day as a picture of the alluvial flats which constitute the whole of the delta of the Tigris and Euphrates. On the Shatt-ul-Arab itself this waste is, indeed, hidden by the fringe of date palms, but behind them it exists without a break or change, except such as greater or less swamp presents, from Amara, Ahwaz, and Nasrie on the Euphrates to the Persian Gulf.

"It is entirely fenny, and one can see nothing for miles but submerged lawns and bulrushes and other sedges, among which immense flocks of wild geese, pelican, and duck pasture. Higher up the river the banks are somewhat more raised, and are fringed with date groves, alternating with barren tracts of camel thorn and stubbly grass, the scanty eatage of the beasts of the villages."

Sir George Birdwood notes also that liquorice grows here. Here and there huge thickets of tall bamboo grass afford shelter to wild pig and a few buffaloes. It is not so long since lions were to be found here, but, if they still exist, they have now been driven far afield, and there seems no recent record of one having been shot. Besides this, tamarisks, willows, and hard scrub are the only plants that break the flatness of the plain.

The one building that breaks this dreary outlook until the town of Amara is reached is the sapphire-tiled tomb of Ezra. This consists of a domed building surrounded by a caravanserai for the reception of pilgrims. After that there is little to attract the eye until the famous 75-foot arch of the palace of Ctesiphon breaks the horizon a half-day journey from Baghdad itself.

Before leaving the immediate vicinity of the Shatt-ul-Arab, the strange sect of the Sabæans must be mentioned. Probably they draw their origin from Zoroastrianism; it is not unlikely that they tinged Mohammedanism with part, at least, of the Unitarianism of the great Arabian creed. It is clear that they draw much of their dogma from the Jews and a little from the Christians. It is owing to this elasticity that they still exist. A church—if the word may be used of a community that is at least consistent in refusing to build any place of worship except of wattles and mud—that can survive in the very centre of the many jarring sects of the Shatt-ul-Arab is worth a passing notice. At present they are conspicuous as a remnant that preserves a secret and most beautiful method of niello work, and worships indifferently St. John the Baptist and the Pole Star.

IX.

The climate of this part of the world deserves criticism. It is open to it, and, to be just, it has always received it. I cannot refrain from quoting to you an Oriental account of the temperature of Muskat. There is no doubt that Muskat is terribly hot, and hot with a wet heat that has an element of terror in it; but the place scarcely deserves this: "The heat," says Abd-er-Rasak, "was so intense that it burned the marrow in the bones.' The sword in its scabbard melted like wax, and the gems that adorned the handle of a dagger were reduced to coal. In the plains the chase became a matter of perfect ease, for the desert was full of roasted gazelles." But in plain truth, Muskat's heat has exacted a heavy toll of Europeans. A place which has known a sun-temperature of 189° F. is not a health resort.

Basra in summer is terribly hot. At the Maidan-i-Naftun, Europeans are compelled to become troglodytes in the summer mid-days. Through August, 1908, the highest shade temperature of the day was often 126°. In London I remember half a panic, because 97° had been reported. Still, if the heat is a dry heat there is almost no limit to human endurance of it, and the man in the East takes no liberties with the sun, and digs himself a "serdab" wherever he finds the natives fleeing underground in summer. In the Shatt-ul-Arab in winter there is often a touch of sharpness in the night, though there is never an actual frost; and there is no impossibility about making a hot weather station among the Bakhtiari Hills, some of which remain snow-capped even in August.

For the rest, Ahwaz is a martyr to "habubs," and the desert wastes of Mesopotamia can provide sandstorms which the Sahara can with difficulty rival. I may perhaps be allowed to show you a curious photograph. The approach of these sandstorms is heralded by a huge canopy of lighter sand, which obscures the sun and warns the traveller of the coming tornado of heavier grit and stones. The photograph which I show you was taken by me just before the storm along the ground struck me. The River Euphrates, a tree, and the silhouette of some village huts can be seen. The darkness during the passing of the storm is greater than that of a total eclipse. Still, life in Mesopotamia and the Shatt-ul-Arab is quite bearable for white men. Worse, perhaps, than the heat are the mosquitoes; and worse than the mosquitoes are the flies.

X.

The approach to the Shatt-ul-Arab from the east lies through the Bakhtiari Mountains. For several years the route has been dangerous, and only the explicit favour of the Ilkhani of the Bakhtiaris will make the journey safe. The beauty of the route is extraordinary, and the archæological remains at Malamir no doubt tempt an occasional visitor to risk the journey from Ahwaz; but the roughness of the tracks—there are no roads—through the mountains is very great, even if one cannot wholly endorse the reference to them in the Sahangusha. "If the pen of description wished to give an idea of the route, so steep and so difficult, it would be lost in the forest of astonishment, and

confounded in the desert of feebleness." I should not, however, have said that there is no road. Here and there one comes across a section of a very ancient road, nothing less than the Ra-i-Sultani, which once led from Persepolis to Susa. But when one comes to a section of this road it is better to get off one's mount and lead him beside it, even if to do so necessitates a dangerous excursion on the edge of a cliff. The photograph will explain what I mean.

The story of the Anglo-Persian oilfield, which lies not far from this remote highway, is one of the great romances of commerce. The original concession was given to Mr. D'Arcy, and hundreds of thousands of pounds were sunk by him at Chiah Surkh, Ram Hormuz, and at last (on the suggestion of M. de Morgan, the excavator of Susa) at Maidan-i-Naftun, roughly thirty miles east of Shustar. At last, at a depth of 1,200 ft., oil was found here, and in March, 1908, a huge jet of black liquid burst through the well, flung the derrick aside and mounted 70 ft. into the air. I was at the oilfields five or six months afterwards, and these photographs may have some interest for those of us who like to have some record of the early stages of an industry that is likely to revolutionise this district in the East.

From the oilfields it is a long day's journey into Shustar, which I found in the throes of civil warfare. I had an order on the acting governor for an escort to Shalilieh, the steamboat terminus on the river, but from the depths of his serdab His Excellency refused it, saying that his men would be ambushed and killed on the way back. It would be all right, he said, if I went through the town openly, as they had no quarrel with Englishmen.

From Shustar one used to paddle down stream in the "Shushan," a hind-wheeler originally built for the relief of Gordon in Khartoum. The other little steamer, which incurred Lord Curzon's comments—they are still remembered by the engineer—has long been at the bottom of the river. Through Ahwaz—where in old days the climate was said to make men lose their wits very soon and certainly—one floats in a ballam down stream to Mohammera, between the bare desert banks which have been described. I arrived on the opening day of the date season in 1908, and ate some. I cannot understand Palgrave when he asserted that satiety did not attend the eating of the date in its own country. I know that I had four of these warm, golden, translucent bags of honey, and I would not eat another date for a year.

XI.

Down the Euphrates there can scarcely be said to be a way at all. In the end of 1911 a venturesome captain took one of Messrs. Lynch's smaller steamers up the river, but though he was a picked man, specially chosen for the work and well known to Arab tribes, he found the difficulties caused not only by the navigation, but by the hostility of the Arabs, so great that it seems improbable that a paying line of communication can as yet be established between Basra and Feluja.

In this connection I may mention, without discussing it, that Willcocks' magnificent scheme of irrigation has, as usual, a reverse side. So wonderfully utilised will the waters of the two rivers be that it is not impossible that navigation during the autumn and winter months may be seriously impeded. Sir William Willcocks is reported to have grimly remarked that his business was irrigation and not navigation. The parallel of Cairo might be adduced. It is not likely that even a full realisation of this great scheme will greatly affect water connections between Baghdad and Basra, except possibly between November and February.

XII.

There remain to be briefly noted three or four matters. The first is the probable effect upon the Turkish Caliphate of our presence in Southern Mesopotamia. The Arabs are no friends of the Turks, and the recent action of Gadban, chief of the Beni Lam tribe round Amara, has been, perhaps, dictated by financial considerations. One thing is clear. Our presence at Basra will do more to encourage our friend, Ibn Saud, the reformer of Arabia, than ten thousand men in the field. An ardent Mohammedan, he knows our traditional respect for the religious feelings of others, and he remembers the proclamation that we issued early in the war to the effect that the Holy Places of Islam would not only be respected, but, so far as possible, protected by us.

The second is the Baghdad Railway. I have no time in which to remind my hearers of the birth of this ambitious project. The German scheme, insh' Allah, has become impossible. There remains, however, much for the Russians, the French, and ourselves to consider as to the carrying through, or partial carrying through, of this plan of linking up Europe with India.

The line of the lower part of it may be traced on the map. Herr Meissner, before journeying westwards to organise the Sinaitic railway, which is relied upon for purposes

of Egyptian invasion, threw hundreds of tons of brand-new railway material into the Tigris, in the hope of blocking the advance of the English. I trust it may be recovered, as, from personal observation, as well as from a curious admission to me by Baron Marshall von Bieberstein in 1912, the plant is of first-rate quality—so good that the German promoters grumbled at the expense. The London and North-Western would not refuse it. As a means of connecting the West with the East the scheme may be postponed. But it cannot be wholly abandoned, and it may be news to some that it is actually in full working order between Raju and Aleppo, Aleppo and Ros-el-Ain, and Samara and Baghdad. From a military point of view these distances of rail are not without importance. From a diplomatic point of view the hiatus is more interesting than the completed line.

The Kurds round Mosul said in 1911 that they did not want the railway, and these mountain Medes have a way of making their prejudices respected. The three gaps in the Baghdad Railway are due, first, to the mountain barriers of the Taurus and of the heights near Suleimanieh; secondly, to the hostility of the Kurds near Mosul; and, thirdly, to the manner of the resolute attitude taken up by England in regard to the southernmost section of the line. I remember well that at a time when the continuation of the track to Basra was supposed to be entirely a matter of arrangement between the two western countries, Marshall von Bieberstein, correcting a statement of mine that Aleppo was a terminus of the line—which in a sense it is—said quickly, "The terminus of our line is not Aleppo. It is Basra."

Something will have to be done with what we may already call our section of the line, if only to utilise the great work of Mesopotamian irrigation.

The third and by far the most important matter is our English responsibility for the administration of these vast alluvial flats. I have no wish to dogmatise on the question. But three points become increasingly clear: (1) We have no right to abandon them without seeing that some form of what Lord Hardinge calls "benign administration" is secured for them; (2) we cannot allow them to return to the administration of Constantinople or of Konia; (3) we have to protect much more than our own material interests. Prestige is a vague and sometimes a misused word; and at this moment I will not use it. But if we wish to protect India, we must protect the gates of India. And if—as I hold—the Shatt-ul-Arab is one of the outer gates of India, we must hold the Shatt-ul-Arab and as much of the land behind it as may be necessary for that purpose. If we do that, we may let the question of our prestige rest for the next half century.

In any case, the completion of the southern reach of the Baghdad-Basra line and the carrying out of the huge projects of Sir William Willcocks, whether by us or with our good will, will lay upon us burdens of watchfulness and preparation, and an eternal possibility of the need for intervention. What will eventually be done lies on the knees of the gods. It is only our immediate task to see that what is certainly the greatest work of administration that man has ever achieved for his fellow man, our government of India, shall not be threatened because, when the day came in which we could have made it secure, we failed through craven fear of being great.

DISCUSSION.

THE CHAIRMAN (the Right Hon. Earl Curzon of Kedleston, G.C.S.I., G.C.I.E.), in opening the discussion, said he thought Mr. Landon had justified the prediction which he had made in his opening remarks, in so far as he had within the space of an hour dealt succinctly and picturesquely with the history, geography and the political status of Basra, the Shatt-ul-Arab and the neighbourhood; indeed, he had cast his net over a rather wider ocean, because he had taken the audience down to Muskat, at one end of the Persian Gulf, up to the Barrage on the Euphrates in another direction, and to the town of Shustar and the oil wells in the Bakhtiari country more to the east. He (the Chairman) was not going to follow Mr. Landon into any of those areas. It was now more than twenty-five years since he had had the pleasure of visiting those countries, and it was with genuine enjoyment and emotion that he recognised sites, once so familiar to him, on the map, and that he saw photographs of places shown upon the screen, every one of which he had seen, with the exception of the Euphrates Barrage, Babylon (which, at the time he was there, was buried underground in great indurated piles of clay and mud), and the oilfields in the neighbourhood of the Karun River, which were only discovered at a later date. He passed all that by for the moment, because the region which Mr. Landon had been describing had an entirely new interest from the events of the past few weeks, to which he proposed to devote a few observations. It had a new interest, because it had become a minor theatre of the

great war in which we were engaged, and of which there was a reminder in the papers only that very morning in the account of the rather heavy fighting which had taken place, apparently within the last few days, in the countries which formed the subject of the paper. He had said "minor theatre of war," but he should be very sorry indeed if anyone were to draw from his employment of that phrase the conclusion that any soldier, be he officer or private, who was fighting, and who very likely, as had happened in several cases, had laid down his life for his country in that territory, was rendering any minor service to the country than those who were engaged in what were popularly regarded as the major scenes of operation in the trenches of Flanders and France—from which, he might say in passing, he returned only the day before—or even in the operation of forcing the Dardanelles. He preferred the poet's old maxim :—

> "Give all thou canst : high Heaven rejects the lore
> Of nicely-calculated less or more."

Every man who was fighting and running risks in the Gulf, in East Africa, in the Cameroons, in Nyasaland, or in the recent riot at Singapore, deserved just as much to be in the eyes, and to receive the gratitude, of his fellow-countrymen as those about whom we were reading daily, and who perhaps only a week or two ago were undergoing that storm of hellfire in the neighbourhood of Neuve Chapelle. Those brave men of whom he spoke did not need advertisement, still less did they ask for it, but it was our duty to give it to them. He had had letters from many of them from different parts of the world, and it could scarcely be imagined what encouragement was given to them in their remote and unfriended stations by merely a mention in Parliament, or by a letter in the newspapers, showing that we at home knew what was going on. Therefore most gladly did he welcome the opportunity of saying a word of recognition of the splendid service which was being rendered by our Indian and other troops in that part of the world. The section of the war line of which he was speaking was of great importance to this country and to India for more reasons than one. In the first place, we were fighting there our enemies the Turks, and we were dealing what he hoped would be a useful blow against a people who had plunged into war with us without the faintest provocation as the result of a perfidious and nefarious intrigue—a people whom we had consistently befriended for years, but with whom, he hoped, we should have no friendly truck for many a long day to come. We were occupying their troops in that part of the world, and incidentally he hoped we were engaged in the process of lifting a hand from those regions which any who had listened to the author would have realised had had a blighting effect for centuries. Secondly, we were carrying out our traditional policy in the Gulf about which so much had been said. There was a new and interesting aspect of the situation in the foundation of that great oil interest to which Mr. Landon had referred, and upon which so many millions of money had been spent with such hopeful prospects of success. Again, a novel interest arose for us from the fact that, as the upshot of these proceedings, it would be our duty to create for those parts of the world a future which should be in consonance with their great and prosperous past, that should give a chance to the people of the country themselves, and incidentally would add to the security of one of the gateways of the Indian Empire. He had spoken about our traditional position in the Gulf. He need not attempt to define it, because that had been done in the admirably clear language of Mr. Landon in his paper, who rightly pointed out that this position had been created by a century of devoted and unsparing effort on the part of Englishmen, consecrated by no small expenditure of treasure and of life. The rights which had thereby been created were, he was glad to say, of universal recognition. Many years ago, when he was a traveller in those parts, he wrote in a private capacity strong words about our position in the Persian Gulf. He had been allowed to publish those words by his late chief, Lord Salisbury, when a few months later he became Under-Secretary for India. It might be taken, therefore, that they represented Lord Salisbury's views and his policy at the time. At a little later date they were endorsed and repeated by one much more influential than himself, namely, by Lord Lansdowne, who was Minister for Foreign Affairs. They had been ratified by subsequent Foreign Ministers, and he had no doubt nothing had been said at that time on the subject which would not be endorsed by Sir Edward Grey to-day. The present war had afforded us an opportunity of placing our policy at the head of the Persian Gulf on a stable and solid basis, which might be expected to give us peace for at least a century. The author had spoken cautiously about the future. He thought Mr. Landon was right and wise to adopt that tone, and he would emulate his example. It was not, he thought, a very good practice to set about discussing the ultimate distribution of territories of which we were not yet in complete possession, and while the war, which was intended to enable us to occupy them, was still in progress. It seemed to him almost as futile a process as that of discussing terms of peace—an attitude to which many of his fellow-countrymen seemed most unaccountably and, as he thought, unwisely prone—before peace was even on the horizon. It must be remembered, after all, that, whatever might be our individual

views or aspirations, peace would not be concluded by us alone. It would be concluded by those who were fighting along with us round a conference table at which the interests, views and desires of all the parties must be discussed in relation to each other, and the issue of those proceedings would be determined by a number of considerations not relating to or representing the views of one party alone. But when that time did come he had not a doubt of one thing—and it ought to be the object of those who had served in India or who were interested in India to see it was so—that at that conference table India, in relation to those parts of the world which had been under discussion that afternoon (just as our dominions across the seas in relation to other parts), should have her place, and that her voice should be heard. Although he thought at present it was wise to speak with great caution about the future, there were certain propositions which might without risk be laid down. The first was that the region which had been under notice that afternoon could not be left in the future to the inept and futile administration of the Turks. Perhaps people in this country hardly realised that it was no natural possession of the Turks; they were interlopers in the country. The inhabitants of the land were Arabs; the Turks were merely a governing and military caste in the towns. The part which was to be played by the Arabs in the future was a much more important question than the part to be played by the Turks. Hitherto we had had most friendly relations with the Arabs, and he endorsed what Mr. Landon had said about the terms on which we had been in recent years with the Sheik Mubarak of Koweit, who had been absolutely loyal and firm in the present crisis, and with others whom he might name. It was a puzzle to him why in the earlier stages of the fighting the Arabs appeared to have sided with the Turks. He did not know enough of the inner history to explain why that was so, but it certainly should be the object of our diplomacy to detach them from the side of the Turks and to resume those pleasant relations with them which had characterised our policy during the last fifty years. His next proposition would be that those regions had immense potentialities both for irrigation, for increase of population, and for wealth of almost every description in the future. He concurred with the author in his remark that Basra was the natural emporium of that part of the world. Usually when for something like a thousand years or more a place had been the centre of a great and flourishing trade there were conditions, geographical, physical and otherwise, which explained its predominance. Those conditions had been clearly brought out in the paper. They would ensure, he believed, a position for Basra in the future as great as it occupied many centuries ago, and he looked forward to the time when Mr. Landon's prophecy would be fulfilled, and when it would again be one of the great and prosperous mercantile cities of the East. There was one other proposition. We could not allow those areas to be the scene again of the political intrigues which they had witnessed during the last ten or fifteen years—intrigues conducted by Powers admittedly hostile to ourselves. He was not going at great length into that matter, but it should be enough for us to say that there must be an end once and for all to all German influence in those regions. The Germans could not be allowed to have any part in the future development of Lower Mesopotamia. He did not think the Turks would have very much part, but the Germans must have none. The Baghdad Railway, designed and carried out for political even more than for economic reasons by the Germans, would no doubt be constructed in the future: but he hoped it would have a different character and a different aim, and he trusted that with such control as we might possess over it, it might be directed not for the advancement of political intrigues, but for the furtherance of the interests of the country itself. More he would not say; the question was very difficult and very complex, and any man who pronounced too definitely upon it now might have reason to rue his rashness later on. For the moment it seemed to him that all we had to do was to see that our troops, who were braving the dangers of desert warfare in an exposed position, and who would shortly be subjected to the extremely exhausting heat of the Mesopotamian summer, should be reinforced by the Indian Government and placed in a position where they could not only hold their own, as they were at present doing, but, if the necessity arose, should be able to push forward their advance. We might be glad that they were led by, and that diplomatic proceedings were in the hands of, such good men. Sir Arthur Barrett, the General in command, was one of the finest soldiers whom the Indian Army had produced in recent years. We might be safe in knowing that our diplomacy was in the hands of Sir Percy Cox, our present Resident on the Persian Gulf and one of the best Political Officers by whom it had been his (the Chairman's) privilege to be served. The administration at Basra was in the hands of Mr. Dobbs, of whom he thought he could truthfully say that he had been trained by himself while he was in India. He desired to add one word in passing of profound and sincere and sorrowing sympathy with regard to Captain Shakespear. Could anything more melancholy be imagined than that this brave and heroic man, who had acquired an ascendency over Arab tribes almost unique, should lose his life in a petty scuffle between native tribes in

whom he had nothing but the most remote interest, and in which he was probably taking part owing to a chivalrous regard for the chief to whom he was attached? It was one of those pitiable happenings which occurred in the world's history, and all that could be done was to deplore his loss and to deposit a mourning wreath upon his grave. In conclusion, there was one thing to be borne in mind. Let them give their support to the Indian Government, and to the Government at home, in endeavouring to secure for those regions, when the war was over, a future that should, on the one hand, further our Imperial interests, render safer than at present the approaches to India, and, even more than that, should take into account the interests of the populations of the country in question.

Sir Hugh S. Barnes, K.C.S.I., K.C.V.O., said it was hardly necessary for him to say much about the subject of the paper after the remarks that had fallen from the Chairman. He agreed that they had listened to a most interesting and instructive paper, well worthy of Mr. Landon's reputation and high quality as an author and journalist. Mr. Landon had enriched his recollections of what he had seen and heard with a wealth of historical detail and an appreciation of the political problems awaiting decision, which had added greatly to the value of his paper; and when this was supplemented by the illuminating and inspiriting speech they had heard from Lord Curzon, he thought they might all congratulate themselves that they were fortunate enough to be present there that afternoon. He had had the privilege of listening to Lord Curzon many times in India and in England, and had always found his speeches in the highest degree invigorating and a healthy tonic against depressed and pessimistic views. He thought they would agree that the speech they had just heard fully came up to that description. There were three points which he would like to mention. The operations which were at present going on in the Persian Gulf should not by any means be made light of. If he, as a spectator, looking on the matter as an outsider, but with some knowledge of the East, were to make any criticism, he would be inclined to say that possibly the Government of India hitherto had rather been prone to make too light of the operations which they had undertaken in that they had not sent sufficient troops at the outset. He believed those troops had since been very largely reinforced, but it was of the utmost importance that it should be remembered that in the operations at Basra the Indian Army were no longer fighting the comparatively untrained troops of Afghanistan or the tribesmen of the North-West Frontier, but were meeting highly organised and trained soldiers, composing practically a European army—men belonging to the races who not so very long ago held the Russians at bay for two months at Plevna, and who recently had gone through the lessons of the great Balkan War. It was of the utmost importance that the operations in the Persian Gulf should be treated in a big way, and that on no account should they be permitted to fail. The success of our arms there was of the utmost political importance for this reason, that there was no doubt that any reverse or mismanagement, in the present high state of tension in the Mohammedan world, might have incalculable results, not only in the Gulf, but also in countries further to the east. Another point was the cynical disregard of Persian neutrality which had been displayed by the Turks and their German preceptors during the course of the war. It would have been gathered from the telegram that had been received that very morning, and from looking at the map, that one of the attacks which had been made upon our troops was at Ahwaz, and that Ahwaz was in Persian territory. It might well be asked why, if Persia was a neutral country, it happened that our troops were there, and that the Turks were attacking them inside the Persian frontier? He did not so much blame the Turks for that. He had lived so long amongst Mohammedans in the North-West Frontier that he had very sincere sympathy with the elder Turks in the plight in which they found themselves landed by the intrigues of the Germanic Powers. The elder Turks might possibly, if we were engaged with them alone, have been trusted to play the game, but we had seen in the West how utterly Germany was inclined to disregard the rights of neutrals when they appeared to conflict with her military advantage, and Turkey had obviously been led by her ally to take the same view of matters in the East. No sooner had the war broken out than the Turks attacked Tabriz in Northern Persia. They were compelled to retreat from there by the Russians, but it had recently been learned that they were again advancing across the border towards Kermanshah. After our occupation of Basra, finding they could make no impression upon our troops on the river, they crossed the border and advanced upon Ahwaz, and it was in that advance that the action occurred, not so very long ago, in which the Seventh and Fourth Rajputs were engaged and in which we lost several officers. That was a direct violation of Persian neutrality. He supposed at some time or another we should hear of the Germans, as usual, reversing cause and effect, and saying that they had invaded Persian neutrality because we had violated it first. But during our advance up the Shatt-ul-Arab Persian neutrality had been thoroughly respected. Not a soldier had been landed on Persian soil until it was threatened by the Turkish armies,

Thirdly, with regard to the German intrigues in Persia, which had been alluded to by Lord Curzon, those intrigues had been well described in that number of the *Times* "History of the War" to which Mr. Landon had drawn attention, and which was a most accurate and complete summary of the rise of our power in the Persian Gulf, and of the attempts which had been made during the last ten years by Germany to undermine it. Those intrigues of Germany had not yet ceased. It was only on February 16th that Herr Wasmuss, the German ex-Consul at Shiraz, arrived in Dizful from across the German frontier from Baghdad, accompanied by the Baghdad agent of Messrs. Wankhaus, who had been the unofficial agents of the German Government for the past ten or fifteen years in the Gulf. They arrived at Dizful with a following of border chiefs. They went on to Shustar, they paraded the bazaar in Persian costume, they sent for all the mullahs, they spent money freely, and distributed leaflets calling on the Persians to join in the Holy War. They then went on through the edge of the Bakhtiari country to Shiraz. The recent *communiqué* of the India Office would also be remembered, which gave an account of the papers which were discovered among the archives of the German Vice-Consul at Ahwaz. He had also seen a letter from Bushire to the effect that Dr. Listermann, the German Consul at that place, had been lately arrested and that papers of his had been found showing he was engaged in stirring up the Persian tribesmen to attack Bushire and destroy all the English residents. It was also known that they had stopped wheat exports from Bushire by the expenditure of money among the Kashgai and other tribesmen, and it had even been said that they had to some extent succeeded in tampering with the loyalty of the gendarmerie under the Swedish officers. All those things fully entitled ourselves and the Russians to take any action we thought justified to support the Persian Government in their resistance to all intrigues of that kind. In one respect he felt inclined to say that we ought to take a leaf out of the German book. Nobody wished that our officers should indulge in the intrigues and falsehoods which had characterised the German manœuvres in those parts, but there was one way in which he thought we might follow their example, and that was by freely expending money among the border tribesmen. He had been a frontier officer in India, and had a good deal of experience of frontier tribes, and among impoverished people like the Arabs in the neighbourhood of Mohammera and Shustar, and also on the Turkish side of the border, money was a great power. In his opinion we could not afford to allow the Germans to tamper with the loyalty of those men by a free expenditure of money without attempting to do something in the same way. He was quite confident that if our Government would put £100,000 at the disposal of Sir Percy Cox, a mere drop in the ocean of our vast expenditure, with instructions to subsidise and employ the Arabs who were now, owing to German intrigues, giving so much trouble in the rear of our troops at Ahwaz and elsewhere in that region, not only should we relieve our officers of a very serious addition to the responsibilities which they had to face, but in all probability we should also succeed in saving very large sums of money and probably a good many valuable lives.

Sir Joseph Walton, Bt., M.P., said he might mention that it was in response to a suggestion of the Chairman that a few years ago he made a journey through Persia, covering practically the whole of the territory mentioned by Mr. Landon. That journey had enabled him to raise, in the House of Commons, the whole question of the Persian Gulf and our predominant interests therein, and he was glad to be able to say that it was no political party question. His resolution on the subject in the House of Commons had been seconded from the opposite side by the late lamented Under-Secretary for Foreign Affairs, Lord Percy, and it received from the Government an emphatic declaration of policy on the lines indicated by Lord Curzon. As the Chairman had stated in his speech, we had somewhat neglected our interests on the Persian Gulf in recent years, but we had a new opportunity to-day in consequence of the war to reconsider our position in those regions, and he rejoiced to know that in Lord Curzon we had a statesman whose powerful advocacy would be available, when the time of arranging terms of peace arrived, in taking care that our interests in India and in that part of the world were properly safeguarded. He would venture to say that those same views would, if occasion arose, be also voiced in the House of Commons by men of all parties, because it had become increasingly recognised that properly to safeguard India we must at any rate have a controlling influence in the lower part of the Baghdad Railway, from Baghdad down to some point at or near th Persian Gulf.

Colonel Sir Thomas H. Holdich, K.C.M.G., K.C.I.E., C.B., D.Sc., said he thought the Society might congratulate itself on having departed somewhat from its traditions in the matter of discussion. After the eloquent speeches which had already been heard connected both with the war and politics, he desired only to say a word or two. First, he wished most sincerely to echo the sympathetic words spoken by Mr. Landon on the subject of the death of Captain Shakespear. Then Mr. Landon had referred to gun-running in the Persian Gulf. There was something very peculiar about the process of

gun-running, and to his mind it illustrated in a very remarkable way the principles of free trade. If he was not mistaken, the guns which were so "run" were manufactured in the first instance in this country. It was a British trade. The guns were conveyed up the Persian Gulf in British ships; they were then carried from the Persian Gulf to the tribes on the Indian Frontier by Afghan caravans, and were sold to those Frontier tribes. How did those Frontier tribes pay for them? He believed they were paid for by money which we ourselves gave to them in order to keep them quiet! He desired to congratulate Mr. Landon on his paper, which both in manner and in matter very nearly reached the best ideal of what a paper of the sort should be.

The Right Hon. Lord Reay, K.T., G.C.S.I., G.C.I.E., in moving a vote of thanks to the author for his paper, said very seldom was it that a reader of a paper was so well equipped for his task as Mr. Landon. This country owed a debt to those who unofficially took the initiative in their travels to do what officials could not always do. Perhaps there was no field in the theatre of war where British interests were more directly at stake than the operations which were at present going on in the Persian Gulf. One thing which should not be forgotten was the valour of the Indian troops and the humane and chivalrous way in which they behaved—which was more than could be said for our enemies. In hearing the list of articles conveyed by the ship mentioned by Mr. Landon he wondered whether they would have been considered as absolute or conditional contraband by the Germans. In conclusion, Lord Reay, on behalf of the Committee of the Indian Section, thanked Lord Curzon for presiding. He had given, as he always did, a most exhaustive survey of the questions which were at stake. He (Lord Reay) entirely agreed with the Chairman that it behoved us to be extraordinarily careful in the way in which we discussed the terms of peace.

Sir John Jardine, M.P., K.C.I.E., in seconding the motion, said he was glad previous speakers had mentioned Captain Shakespear's name in terms of full appreciation and great knowledge.

The vote of thanks was then put and carried, to which Mr. Landon briefly returned thanks, and the meeting terminated.

SEVENTEENTH ORDINARY MEETING.

Wednesday, April 21st, 1915; The Right Hon. Walter Hume Long, LL.D., F.R.S., M.P., in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Baw, U. Kan, K.I.H., Pyinmana, Yamathin District, Burma.

Bright, Charles, F.R.S.E., M.Inst.C.E., M.Inst. E.E., Members' Mansions, Victoria-street, S.W.; and The Grange, Leigh, Kent.

Griffin, Louis T., The Auckland Museum, Auckland, New Zealand.

Humphrys, Claude William Erskine, Penang Rubber Estates Co., Ltd., Province Wellesley, Penang, Straits Settlements.

The following candidates were balloted for and duly elected Fellows of the Society:—

MacCaw, Vivian Hardy, 21, Strand-road, Calcutta, India.

Pardiwalla, Jehangir Pestonjee, Hotel Majestic, Bombay, India.

Saunders, Alfred Oliver, 25, Newport-road, Moseley, Birmingham.

Spence, Charles Stewart Traill, Plantation Waterloo, Nickerie, Surinam, Dutch Guiana.

The Chairman, in introducing the lecturer, said the subject was especially interesting at the present moment, because, while everybody was thinking out the problems connected with the present war, the time was also being looked forward to when—the war having been terminated in the only way which citizens of the British Empire contemplated as possible—it would be necessary to make provision for those who had taken part in it. Doubtless many of the soldiers and sailors who were doing such gallant deeds for their country on sea and land would not be able to return to their original vocations, and many of those who were physically able would not be inclined to return to the narrower and more limited possibilities of life in the old land. And just as the war was being fought by the whole British Empire, just as it was realised that in the immediate future participation in the consideration and settlement of Imperial questions by our oversea dominions was a necessary consequence not only of the war but of all the great events which had preceded it in our history as an Empire, so it was felt that the dominions would take their part in offering facilities and opportunities to our soldiers and sailors to find new openings for themselves in distant parts of the Empire. It must, he thought, be true that great openings would be found in connection with the fishing industries on the two coasts of the Dominion of Canada, and no doubt in other parts of the dominions all over the world. He could not help thinking that there was an immense industry to be created and developed in connection, especially, with sea fisheries. He believed that in Canada on both its coasts there were great potentialities, great sources of wealth, great possibilities of industry, and at the same

time the climatic and other conditions were such as to make life in that country agreeable. Consequently it must be specially interesting to hear one, who would speak with great authority acquired by personal investigation and knowledge, upon such an extremely engrossing subject. He (the Chairman) believed we were only just beginning to realise what were the opportunities offered to us as an Empire, how vast were our possessions, how great were the fields open; and while, in common with everybody else, he profoundly regretted that the war had been forced upon us, the loss of dear and valuable lives, and the heaviness of the burden which had been cast upon this country, he yet believed that to that cloud—black, dark, and heavy though it was—there was a silver lining to be found in the new birth of the British Empire, with immense possibilities before us, with a great strengthening of the bonds that bound us, and with the realisation of the fact that the Empire in future would be one in reality and not only in name, and that all parts of it would be bound together so that we should make the best possible use of it; and he believed the end of the war would see the British Empire able to maintain itself, to defend itself, and to hand down to generations yet unborn a heritage even greater, more priceless, more real than that great one which we had received from our predecessors.

THE AUTHOR prefaced his paper by saying that the fisheries of this country, only a few years ago, had been neglected by the Board of Trade in an extraordinary manner. After some moderate agitation on the part of the few who were interested, the fisheries were handed over to the Board of Agriculture, and if the Chairman had remained a short period longer at the Board of Agriculture, he would have been in charge of that immensely important industry. He (the author) hoped, by effluxion of time, the fisheries would be got out of the Board of Agriculture and into a Department of their own. Every other nation which attached a proper value to its fisheries had, in the last thirty years, made a department of them, and with remarkable success.

The paper read was—

THE STATE AND THE FISHERMAN.

By MORETON FREWEN.

The great crisis through which Europe is now passing must inevitably turn men's minds to the problems of the ocean. The world we inhabit is made up of seven portions water and three portions land. It is no extenuation of the crime of Germany if we admit that no first-class nation can in these days enjoy any real place in the sun unless it has also easy access to the sea, and this not merely to a port here and a port there, but through the possession of a wide littoral. When the history of these days comes to be written, we may discover that the decline and fall of modern Germany and Austria were inevitable, and were not owing to the jealousy of rival nations, but to the evident geographical fetters by which those communities were cribbed, cabined, and confined. Germany is by nature a poor country, but inhabited by a vigorous, highly educated, progressive people, who have built up a vast and artificial industrial mechanism on a foundation of successful foreign, water-borne trades, the expansion of which trades is only possible by permission of their neighbours—a permission which will always be contingent on good behaviour. Thus the German peoples have enriched themselves, relying on a toleration which will in future be withdrawn. Probably the days of Germany's foreign commerce and factory system, did she know it, are already numbered; a large proportion of her people may again, as before 1870, find relief through emigration, and those who remain in their Fatherland will revert to more restful and agrarian occupations. Not so the British Empire, France, and the United States, nor indeed Russia, should the future of Russia include the lines of the Bosphorus. Such nations as these, their heritage enriched by easy access to the sea through numerous ports, will be found, in the centuries at hand, the fittest to survive. And the relative economic advantage of this access to the sea must all the time grow greater and not less. Modern mechanical developments tend to aggrandise the ship rather than the railway train. It is safe to say that the cost per ton per mile for railway freights will always be ten times greater than for ocean freights. Even the prodigious developments now at hand in aeronautics are likely to be chiefly valuable as ancillary to the shipping interests of communities. It is not the purpose of this paper, however, to point out why German prosperity for the past hundred years has resulted less from her successful predatory onslaughts on unready neighbours than from the spread of those economic theories amongst the non-German peoples which had for their objective a cosmopolitanism with which it is difficult not to sympathise, and which theories have been to us and to others a menace, chiefly because they do thus attract our philosophic sympathies.

These economic portents arising from the Great War will deserve the consideration of a new generation of students, and will no doubt

work their way through the Western legislatures after considerable delays and with differing results. Paul Voigt, a careful German economist, wrote some years since this note of warning, which perfectly exposes the Achilles heel of modern Germany. Voigt says:—

"The loss of our export trade would bring starvation to the masses of German workers and compel them to emigrate and to beg before the doors of foreign nations for work and food. The collapse of our export trade would be the most terrible catastrophe in German history, and would rank with the Thirty Years' War as a calamity. It would wipe out the German nation from the great nations of the world, and might end its political existence."

But it is to quite another ocean, to the ocean as a source of food supply, that this paper invites your consideration to-day. Our people, the world over, are the greatest of the meat-eating races. We have awakened to the recognition that the world is confronted with a very alarming shortage in its meat supply, and unless for a quarter of a century to come we can develop a more vegetarian habit, the meat problem appears quite insoluble. It is here that the fisherman, with the generous assistance of the State, may come to our aid.

I recall many years ago, I suppose at least forty years, reading a very interesting letter to the *Times*, written by the late Sir John Lawes. In this letter Sir John Lawes pointed out that the meat yield per acre of the English Channel off the Nore was equal to the meat yield of about a hundred acres of the best Northamptonshire grass land. Sir John Lawes wrote to support a theory that the more sewage our great cities dispersed to the sea, the larger the yield of fish. But great though his authority in this field of cosmic chemistry, I think it has since transpired that the meat yield of the ocean is not related, and happily not related, to cities and to the sewage problem; but it is related rather to the food supplies for fishes which Nature has herself sowed in one ocean more lavishly than in another. As I shall point out later, nowhere is the ocean common so fabulously fertile in fish life as in the North Pacific, from Behring Straits to Vancouver, and yet this is a region where its waters are less polluted by the sewage of cities than any other in the world—unless the Arctic and Antarctic. However, theories apart, the fact remains that the great ocean off the shores of our British Islands is very rich in food. In the Report of the British Sea Fisheries Commission of 1867 (Vol. I. p. 16), the weight of fish sold daily in the London market was given at 300 tons, which at that time was nearly the weight of the beef sold in London. Three hundred tons of fish per day! Truly such a figure looks imposing. But let me contrast it with an estimate prepared for the United States Senate, in 1887, by that very competent authority, Professor Elliot, of the yearly fish consumption of the seal herd of the Pribyloff Islands—six million tons a year, or some fifteen thousand tons per day! Congress at that time was being invited by our Government, and by the Canadian Government, to suppress pelagic sealing—the killing of seals on the high seas. The Pribyloff seal herd has since, and perhaps in consequence of Professor Elliot's evidence, been largely reduced; but whether the fabulous fish supplies of the North Pacific show any increase since 1887 I have no evidence to show.

Our time will not permit me to go more fully into this problem, namely, whether an acre of water or an acre of land has the greater productivity. It is a question of great importance to our sociology, and, in the days at hand when the prices of beef and mutton will probably be much higher, will lead to frequent discussion. It is enough now to point out that everywhere the modern State must treat its fisherman as it treats its soldier, and by all the means at its disposal the State must protect our great ocean pastures, restoring the balance of Nature, where necessary, by destroying predatory and worthless birds and fishes. Here is a British industry in which the capital employed is only some £12,000,000 sterling, and yet the gross annual return is over £10,000,000—a return to capital far greater than is the case in any other industry; and yet our entire State expenditure on our fisheries, both salt and fresh, is only £40,000 a year. Compare this expenditure with £207,000 a year in the case of Canada, and at least £700,000 a year (Federal and local) in the United States. The fishing cobbles and smacks of our coast counties are the real cradles of our merchant marine and of our warships too. Great Britain's fleet of steam trawlers to-day exceeds in number all the trawlers of Europe combined, and yet our national expenditure on our fisheries is hardly more than that of Norway and Sweden, and only one-fifth of that of the Dominion of Canada.

Let me now ask attention to the modern history of the famous American shad (*Clupea sapidissima*). This is one, and the very best, of our anadromous fish—fish such as the salmon, which feed and fatten only in the ocean, but

which are impelled by nature to ascend our rivers in order to spawn. The American shad is of all their table fishes probably the best. When England first colonised the Atlantic seaboard, the shad, during its spring migration, was the cheapest and most abundant of all their river fishes. But towards the middle of the last century this important food fish had been almost extirpated. Even as the canvas-back duck to-day, the shad was the dish of the millionaire. Mr. Seth Green, who, next to Professor Spencer Baird, may be regarded as the father of the American school of ichthyology, was able, after innumerable experiments carried on at the cost of the Federal Fishery Department, to hatch the eggs of this fish in syphon jars—jars that resemble a soda-water fountain. From this development, hardly noticed at the time, all else has followed, until to-day the shad is again one of the most important of the American food fishes. Re-established in the Atlantic by these cultural methods, next, in 1871, it was transported by the California Fish Commission from the Hudson River to the Sacramento River on the Pacific. The report of the Washington Department for 1898 has this to say of a modest planting operation:—

"Remarkable success has attended the stocking of the waters of the Pacific coast northward from Monterey. In 1871 shad fry from the Hudson River were liberated in the Sacramento River by the California Fish Commission, and in 1873 the U.S. Fish Commission made a second deposit of 35,000. Subsequent plants in the Sacramento, aggregating 609,000, were made by the U.S. Commission. From these small colonies, amounting to less than one per cent. of the number now annually planted in the Atlantic coast rivers, the shad have multiplied and distributed themselves along nearly three thousand miles of coast from Southern California to South-Eastern Alaska. The shad rapidly made their way up the coast from San Francisco Bay. They reached Rogue River, Oregon, in 1882. In the Columbia a few were taken as early as 1876. About 1881 they were on the coast of Washington, reaching Puget Sound in 1882, they appeared in the Fraser River, British Columbia, in 1891, and in the Stikine River, near Wrangell Island, Alaska, lat. 56° 30′, the same year."

I may gratefully record that the officials of the Washington Department, with their accustomed public spirit, sent me nearly two million shad eggs and Green's syphon jars, some years since, to Innishannon in Co. Cork, thinking it possible that by the very fastest passenger steamer some of the ova might arrive alive. But all died in transit. The period of incubation for the ova of this fish is only five days, and a successful experiment would involve either, as in the case of the California experiment, the movement of the fry or the hatching out of the eggs with fresh water on shipboard.

I have drawn your attention to the very short period of the incubation for the ova of the shad, which makes it impossible to import eggs from a river in America to be hatched in this country. In the case of the ova of all the salmonidæ this is not so. I have delivered eggs of the rainbow trout (*Salmo irideus*) in perfect order in New Zealand. And it is well to recall that, thanks to the public spirit of Messrs. Hinde and Grogan, the ova of the ordinary brown trout (*Salmo fario*), only eight years ago, travelled out to East Africa by the ship in which I was a passenger, and, after hatching, the fry were planted in that lovely mountain stream at Nyeri on the slopes of Mount Kenia. So that to-day trout, often 4 or 5 lbs. in weight, swarm throughout the Kenia watershed, an addition of untold value to the worth of life on that plateau than which there is nothing finer, whether in climate, sport, or scenery, under our flag. I should expect the beautiful but elusive rainbow trout, which has been a disappointment to us breeders in Great Britain, to prove a success in the mountain streams of Kenia and the Victoria Nyanza. The rainbow trout is probably the steelhead salmon (*Salmo gairdneri*) of the Pacific, that by some accident had got land-locked. Released in our streams, he starts off without delay to his ocean home, though, unlike his cousin *Salmo salar*, the rainbow has no homing instinct for the river which rocked his cradle. But from the streams of this African plateau it would be impossible for the rainbow trout ever to reach the ocean. After travelling a couple of hundred miles, the river water under an equatorial sun becomes much too heated for the further passage toward the ocean of any of the salmonidæ. In the *Nineteenth Century Review* for September, 1899, I gave a detailed account of the operations of the United States Fish Commission, and described the spread of trout hatcheries in the Rocky Mountain area as constituting a valuable cottage industry. Of the trout farm of Mr. Sherlock, two miles from Salt Lake City, I wrote: "Mr. Sherlock tells me his feed bill for a quarter of a million fish is but a sovereign a month, and he retails his produce for 2*s.* a pound. The yield of his quarter acre of artesian well water is not less than £600 a year."

In addition to the shad, another splendid Atlantic fish, the striped bass, was moved by the Federal Fish Commission to the Pacific. The report of the Commission (1896, p. 141) has this to say :—

"The market value to the fishermen of the Pacific coast of the shad and the striped bass, taken between 1888 and 1896, was about 192,000 dollars. The aggregate expense of introducing these fish to the Pacific was under 5,000 dollars."

Two generations of men have come and gone and few dwellers on the Pacific now recall that fifty years ago, and at a cost of only a thousand pounds, these two superb table fish were presented by the Atlantic to the Pacific, and that the dwellers to-day on three thousand miles of coast-line are, did they but know it, the beneficiaries forever of that prodigious legacy bequeathed to them in 1871 by the Federal Fish Department.

Read also the report of the Canadian Fishery Department for 1899 :—

"On July 8th there had been planted in the waters between Caribou and Pictou Island a hundred million young lobsters. Each year adds more lobster factories on our coasts and more traps on the fishing ground, and it is surprising to all that the lobster fishing is holding out. The fry from the Bay View Hatchery has been planted in Pictou Bay, and I agree with the packers and fishermen who believe that the good fishing around this locality is largely due to the hatchery."

The recent history of that superb fish, our *Salmo salar*, in the United States, is of all the most interesting. When the Pilgrim Fathers reached New England this fish swarmed into every river in New England. Fifty years ago in those rivers and the rivers of Maine and New York State, *Salmo salar*, owing to river pollution, sawdust and traps, had become practically extinct. Next the ova of this fish, purchased from the Canadian Government for £10 a thousand (a large hen fish would carry twenty thousand) were hatched, and the fry liberated in the Penobscot River. To-day the yield of that river is some ten thousand salmon a year, and *Salmo salar* from a score of New England rivers is now fairly cheap in all the markets of the Eastern seaboard. In these islands of ours, were the State to tackle resolutely the salmon problem, the price of this fish, which is now prohibitive, might well be reduced to 6*d.* per lb. But this problem of salmon culture is hardly less controversial than is Sir Robert Peel's Bank Act! It is technical in the highest degree, and with regret I must regard it as quite outside the scope of this paper. It is enough now to say that the anadromous fishes, such as the sturgeon, the salmon and the shad—all fine food fishes that pasture only in the ocean, and from those feeding-grounds bring a feast of fat things a hundred miles up our rivers to our very garden gates—fish these which make no demand on our rivers for their food—should constitute an important, welcome and cheap source of food supply in these islands. I take the following figures from a recent report of the California Fish Commission. Mr. Smiley writes of the operations of the great State salmon hatchery at Baird, that its annual yield, at an average weight of 7 lbs. per fish, is 4,391,882 lbs.; the selling price of salmon is 3½*d.* per lb.; the cost of hatching and distributing is £720 per year. Of another of their State hatcheries, at Battle Creek, he writes that nearly fifty million salmon eggs are being secured each season. On such a scale are the operations of the California State Commission. The Federal Fish Commission, operating from Washington, supplements the activities of the various States by hatching and distributing free of charge two hundred million lobsters and more than a thousand million fish of all sorts.

From what a small beginning—the mere hatching by Green of a tiny embryo in a syphon jar—the great shad fisheries of two oceans date their prosperity! And scientific successes perhaps equally important await the Frank Bucklands, the Seth Greens and the Spencer Bairds of to-morrow. For we stand to-day upon the threshold of the unknown. What alone we know is that the entire biology of the ocean involves an endless chain of life evolved from death. There is a shrimp so atomic that eighteen thousand have been counted under a microscope in the stomach of a single herring. Thousands of such herrings are required for the daily provision of a single whale. It used to be said that Holland, Mistress of the Seas, with a vast world-wide commerce, was built up on the herring; but the fact remains that in the ocean every intervening organism in the vast continuous chain of creation, culminating with the giant sperm whale, is based upon a shrimp scarcely visible to the unaided human eye. I have touched on the triumphs of science in creative operations—in the hatching of shad and lobsters and salmon; but perhaps equally important, if we are to get the full harvest of the ocean, is it that we should undertake the careful destruction of worthless and predatory fishes and birds. It is conjectured that the

gannets off our coasts consume more herrings than are captured by all the nets. The destruction of salmon smolts in our estuaries by sea-gulls very probably aggregates one half of all the salmon smolts which run down our rivers. That worthless bird the cormorant, it is known, consumes daily 50 per cent. of its own weight in fish. I confess to the desire to see the ranks of our cormorants, and herons also, greatly thinned. And yet any such process of elimination must needs be exercised with great care. For example, one of the worst enemies of the net fisherman is the dogfish, which often takes a heavy toll of the fish enmeshed in our stake-nets. But, on the other hand, the principal food of the dogfish is the starfish, and the starfish is voracious of the spat of the oyster. When Professor Elliot pointed out that the fish consumption of the Pribyloff seal herd in the North Pacific amounted to six million tons yearly, we must not assume that this mass is chiefly salmon and halibut, the two most valuable of the North Pacific fish. It is probable that the seals consume a proportion of coarse fish, which fish themselves prey upon the more valuable food fishes. There is everywhere, and especially in the case of the ocean, a mysterious imponderable balance in Nature which man must be careful not to upset—a balance, did we know it, not less important than is the balance of power in Europe.

I now come to a consideration which is of all the most essential before we can establish our claim for liberal expenditures by the State. If we regard the ocean as a source of supply for the mere raw material of the wealth of nations, what is the cash return to the labour employed on this material? I believe it can be proved that, of all our primary industries, the ocean fisheries require the very smallest capital outlay and yet pay the very richest return of all to the labour employed. If this is the case, then any deputation which waits upon any Chancellor of the Exchequer on behalf of our fisher folk occupies ground of great advantage. I have already noticed that the capital employed in these islands—our ships, our boats, our nets, etc.—aggregates twelve millions sterling, and that the gross annual income derived is not less than 90 per cent. There are 80,000 workers in this field; probably one-third of these are boys whose wages in field or factory work would be small. Thus the yield per worker is £125 per annum, and by referring to our new Wealth Census of Production we discover that the value of the product of the skilled worker in our factories (if we deduct the cost of the raw material supplied) averages a full third less than the value of the product of the fisherman; and in the case of agriculture the yield is a full half less. Some years since I investigated the wealth yield of the Canadian fisheries. In 1885 there were 60,000 hands employed in 1,177 vessels and 28,472 boats. The total capital expenditure was £1,200,000 only. The entire population, both workers and dependents connected with the Canadian fisheries, numbered 147,543. The gross value of the catch in a season of four months only was over three and a half millions. Whereas when I was in New South Wales in 1896 there were in that Colony 160,000 people connected with agriculture, and the value of their product was for the full twelve months only three and a quarter millions. I should point out that these figures would require some adjustment to-day, as in the past fifteen years agricultural products have advanced in price more considerably than the price of fish. In the case of the four States of Pennsylvania, New York, Maryland, and New Jersey, the capital invested in fisheries is £3,000,000 and the gross annual yield is also £3,000,000; the wealth product for the year per caput (and in this I include all the dependents) is no less than £121. In Lake Ontario again 206 hands are employed during a season of five months in connection with the white-fish and lake-trout fisheries. The value of their take in the five months is nearly £217 per caput.

I must not occupy our time by enlarging on these returns. It is enough to say that the return to the labour of a pair of hands at sea is far greater than the return on land. Only in the case of highly-skilled labour employed on highly-priced raw material, where, indeed, the value of the raw material is one-half or even two-thirds the value of the finished product, can we show such earnings as those which comparatively unskilled labour derives from that great ocean common which is free to us all.

I shall conclude by drawing your attention to the really amazing marine biology of the North Pacific Ocean. In preparing this paper at this time I have desired chiefly to invite public attention to the stored wealth of that ocean, hoping that, on some of the numerous and beautiful islands lapped by the Pacific, fishing colonies may be established for partially disabled soldiers and sailors, and, indeed, for those soldiers and sailors who suffer from no such disability, but who aspire to the wider and freer life which awaits them in the outer Empire. In my mind's

eye I can see a score of beautiful and at present desert ports and harbours along the coast-line from the State of Washington to Alaska, where Nature, as in British Columbia, has done her work with a partiality and a prodigality quite unknown elsewhere. Such sea fisheries; such river fisheries; with a season not as in the Atlantic of five months, but of at least ten; the fishing operations conducted not as in the North Sea or in the west Atlantic, under conditions of great hardship and even danger, but in the security of beautiful land-locked fjords and on summer seas. These are conditions which must insure, given this increasing pressure on our meat supplies, the very rapid settlement of that beautiful coast. A colony of ex-soldiers and sailors, a proportion of the number carpenters, blacksmiths, and masons—the larger their families the better—who will charter a ship, can now conclude a continuous voyage *via* Panama at some well-sheltered harbour in the Queen Charlotte Islands, within three weeks from Liverpool. The sawmill they take with them will clear their townsite of the big timber trees and convert these speedily into houses. On the coast of British Columbia the contract price to-day of a spacious four-roomed cottage with kitchen and bathroom is only £100.

Of these Pacific fishing-grounds Professor Edward Prince, of the Dominion Commission of Fisheries, writes:—

"These fisheries are amongst the most prolific and valuable in the world, and they are capable of immense expansion. Their leading feature is that they can be carried on in waters perfectly land-sheltered. Hecate Straits, Dixon's Entrance, Queen Charlotte Sound, and the Straits of Georgia, with innumerable deep inlets, bays, and arms, are so shielded from the ocean as to furnish unique conditions for the pursuit of fishing. The investigations carried on by a committee of the British Columbia Fishery Commission of 1906, proved that extensive feeding-grounds for fish occur on every part of the coast. The bottom is in numberless places literally alive with invertebrate animals, especially shell fish, anelids, shrimps, and sand stars, which constitute a very large part of the food of the most esteemed kinds of marketable fish. The greatest spawning and feeding-grounds in the world for herring, cod, plaice, halibut and numerous other food fishes occur within this vast and sheltered area, which covers nearly thirty thousand square miles. The Fraser River, Columbia, Thompson, Skeena, Naas, Stikine, Liard, Yukon and other vast rivers, all have their sources in British Columbia, and most of them rank as the greatest salmon rivers in the world."

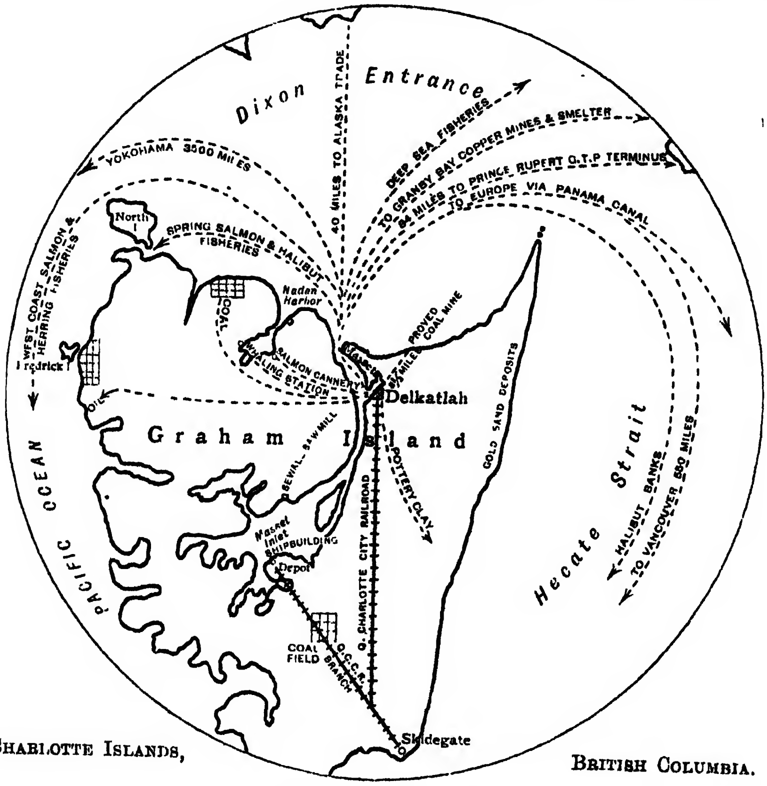
From September to April the fish are taken on long lines in the deep water; from April to July the fish, especially the halibut and salmon, come in vast shoals into the fjords, harbours, and estuaries. Colonel Newberry states that while on one of the steamers of the New England Fisheries Company he tallied a capture of 165,000 lbs. of halibut in five hours. Sir Richard M'Bride, the Premier of British Columbia, was probably on safe ground in saying that "experiments have established the fact that an hour's trawling on the Atlantic coast of Canada will bring up more fish than can be captured in six hours in the North Sea fishing-grounds, and as it is conceded by the best authorities on the subject that British Columbia's fisheries are immensely more productive than those of the Atlantic, it follows that our fisheries would support a million people without taxing them to an appreciable extent."

Hitherto the fish of this region has had to be carried south by any passing steamer six hundred miles to Vancouver or to Seattle, and from one or other of these ports conveyed by rail to the eastern markets; but last summer the Grand Trunk Railway system was completed to the Pacific Ocean, at the harbour of Prince Rupert, and is already delivering fish, chiefly halibut and salmon, in car-load lots of 20 tons at Winnipeg, Chicago, and Montreal, and at a freight cost of only 1½*d.* per lb. to Montreal, some three thousand miles east.

The great cold storage fish market in Prince Rupert pays over the counter 2*d.* a pound for halibut and 3*d.* for salmon. Beyond question a very few years will discover Prince Rupert to be the greatest fishing port in the world. When we consider the land-locked conditions under which the fisherfolk in these regions ply their trade; their safety from storms; the length of their season; the incredible wealth of their ocean; the fact that they have a continent with over a hundred millions of people to supply—people whose purchasing power and food-consumption is built up on a rate of wages nearly three times higher than Europe's—it is difficult to resist the conclusion that the cash return to each pair of hands employed in these Pacific fisheries must be three or even four times greater than in the case of our home fisheries. The settlement I have in mind might be on the north shore of Graham Island, eighty miles west of the new town of Prince Rupert. The distance from Prince Rupert to Yokohama is only 3,500 miles, and this new route to Japan will save two or even three days over any existing route from Europe. A service of fast passenger boats from Prince Rupert to Japan

is projected for 1917, and these boats, passing along the north shore of Graham Island, will give that great island and its industries most convenient access both to the mainland and to the Orient. The soil of Graham Island is said to be fertile, and already vegetable and dairy products from its settlers are coming by a weekly steamer to a good and growing market in the town of Rupert, which, founded in 1908, six years ahead of any railway connection, has already a population of over seven thousand people.

famous in the history of the Pacific coast, will work for the future of the Queen Charlotte Islanders even while they sleep. And from Northern British Columbia as a centre, great industrial developments now radiate. If we include the coming expenditure of the United States on the Alaskan railroads, for the immediate construction of which Congress last year voted seven millions sterling, it is safe to say that during the next five years twenty millions sterling will be spent in railway construction in the immediate vicinity of Prince Rupert. The



CHARLOTTE ISLANDS, BRITISH COLUMBIA.

If a colony of five hundred people, to include wives and children, were planted in some carefully selected harbour of the Charlotte Islands, and a sufficient area on the harbour were surveyed and secured to accommodate a future town of ten thousand inhabitants, the rapid advance in the value of the townsite lots will in the next few years enable such a settlement to finance itself on a most generous scale. The operation of the Panama Canal, revolutionising as it must trade relations between the Orient and the Occident; the opening through to a really magnificent harbour, Prince Rupert, of the Grand Trunk system—these two events, which made 1914

coming summer will see completed at Prince Rupert by the Dominion Government of Canada the greatest dry-dock on the entire Pacific coast, a dock capable of receiving a ship of 25,000 tons. And while the rate of wages in British Columbia is about the highest on the American Continent, the cost of living, if I exclude the southern States of the Republic, is probably the lowest. Cheap food supplies from the great prairie provinces of Saskatchewan and Assiniboia are near at hand, and, looking west, now that direct trade connections are about to be established with China and Japan on the coast opposite, there should be a downward trend in the price of clothing and other

commodities manufactured by cheap Asiatic labour.

But to conclude. What is the real outstanding lesson of this bloody war? Surely it is the value of the fighting man, and the value of the mother of the fighting man. How, then, can we in future keep our citizens within our own community—how fill our own waste places with our own people? The late Mr. Blaine, of Maine, once priced to me the value of an able-bodied immigrant of either sex at £300. Does anyone to-day regard that estimate as excessive? Depend upon it a generation of our statesmen of the future, who are to-day in our schools, will discover that the national policy of the British Empire is founded on that recognition and no other—the value of the *Civis Britannicus*. For the past fifty years, owing to "the canker of a long peace and quiet times," we have ignored entirely the value of the man; we have with a light heart flung our men out, sink or swim, into any foreign citizenship.

We shall now discover that any expenditure is profitable which will keep our own people both prosperous and in touch with us, and no finance has an economic foundation so well and so truly laid as that which assists our people to do business in the great waters where it is their privilege from day to day to bear grateful witness to "the works of the Lord and His wonders in the deep."

DISCUSSION.

THE CHAIRMAN (the Right Hon. Walter H. Long, LL.D., F.R.S., M.P.), in opening the discussion, said Great Britain had undoubtedly been troubled by the problem of excessive population. It had puzzled all thinkers, especially social reformers, and it was well known that years ago Cobbett foresaw in the growth of our towns the destruction of what he called English life and all that was best in rural life conditions. This country very suddenly went through a great change. Having been a rural country, and having faced the last great war, which was in any degree to be compared with the present conflict, with a population infinitely smaller than the present population, all at once we developed our great commercial position. Some of our largest and most prosperous towns grew like mushrooms in a night, and the whole nature and face and condition of the country were altered. That change had been steadily progressing. When he first entered Parliament, some thirty-six years ago, the House of Commons was beginning to change, but it still retained at that time a great deal of its old complexion. A great many of the old country elements were left. What was called the "country gentlemen party" was at that time a powerful party with a great historical past and with great influence; but the influence of the towns had made itself felt upon each successive Reform Bill, and as time went on it had been found necessary to give increased representation to the big towns. As he had said, the population of this country had increased enormously, and between twenty-five and thirty years ago, when it had been his duty to look into the matter with the hope of discovering some solution for the difficulty, the idea of emigration occurred to a certain number of people. That idea, however, had been contemplated with horror by a great many persons, especially by those who claimed the right to speak for the working-classes. They said, "You say there is no room for the people here. You advise them to emigrate. In other words, you tell them to leave their own homes and their own kith and kin and go to distant lands." He hoped that one of the changes that had taken place during the last few years preceding the war would be emphasised by the war, namely, that the word "emigration" would be forgotten as regarded the British Empire, and the word "migration" be substituted in its place. In other words, that it would be realised, as it had never been before, that the British Empire was one, and that to go from England to Canada, or from Australia to England, or from South Africa to Australia, was not emigration—going from home to a strange land—but was merely migration, going from one part of one's country to another. If he were right, then surely the paper was of enormous value, because if our people could be told that they could not only move from one part of the Empire to another with the certainty of finding there people of their own kith and kin, but that in addition there were open to them vast fields of wealth which they could occupy and develop for themselves and for their country, surely the solution of some pressing social questions would be nearer to accomplishment than ever before. Large numbers of magnificent fellows had been fighting as even British soldiers had hardly ever fought before in the whole of our long and glorious history. Think what the strain must have been on their minds as well as their bodies of continued trench warfare. Was it not probable that a great many of them, after spending their time in such tremendous excitement, would never consent to resettle in the narrower surroundings of the old and developed land at home? They would ask for some place where they could open their arms and stretch their legs and feel there was room to turn round, and this country ought to be ready to point them the road to lead them to what they wanted and which would give them an assured future; and the paper showed one of the ways.

MR. W. H. PIBEL said he was afraid very little had been heard that night about the state of the fishermen. What the author had said about the

wealth of the Canadian fishery was right and true, but that did not affect the fishermen of this country, for whom there was plenty of work here. In passing he might draw attention to the fact that there was one class of men who had done even more than the soldiers and sailors (of whom he desired to give the greatest praise) for the good of the country, and that was those men who went trawling for mines; and the man who had done the greatest work among those men was perhaps the man who was least considered, namely, the stoker in the hold. Those men were fishermen, and it was to be hoped they would be fishermen again; but the difficulty which had to be considered was that at the present moment, the quantity of fish being caught being less than half the normal amount, the means and methods of distribution were getting gradually less, and if things continued as they were, when the fishermen came back again they would find great difficulty in getting a market for their fish. What had to be considered was not the emigration of fishermen, but seeing that the work was available for them when the war was over.

Professor E. W. MacBride, F.R.S., said there were one or two points in the paper which had rather surprised him. One was the great reliance which was placed on the hatching of fry as a means of increasing the yield of fish. He was quite prepared to believe, in the case of fish which laid their eggs in fresh waters, that this had been of service in the past and would be of service in the future, but he had the authority of one of the greatest fishing experts in the world, the Superintendent of the Fisheries of Norway, for doubting the value of any such process when applied to salt-water fish, and especially in the case of lobsters. With regard to the question of the future of Canadian fisheries, he quite agreed with the author as to the enormous fecundity of the Pacific coast of Canada, but one great difficulty always occurred in all schemes for increasing the fishing population on the Pacific coast, and that was the great distances to the markets. It had to be remembered that the fish, even after being landed, had to be carried over 600 miles of mountains, and then had to be conveyed several hundreds of miles on the railway before it reached a market, and that market was not like the London market, but one of comparatively small size. He thoroughly agreed with the previous speaker that this country could not be too grateful to the fishermen for what they were doing in the present war, and for that remark he had the authority of Lord Lucas.

Mr. G. L. Alward said the idea of drafting out a surplus population to deal with the Canadian fishery was a most laudable one, but the difficulty in Canada was exactly the same as in this country, namely, of getting the fish distributed, and also, in the case of Canada, of educating the people to eat the fish. Before anything serious could be done in the matter it would have to be found out how long it would take to develop the same desire for fish among Canadians as at present existed among persons in this country. With regard to a remark of the last speaker, he had seen fish which had been sent overland in Canada, and it had not been in a very enticing condition on arrival. For those reasons he considered it was not quite possible yet to send soldiers and sailors to that distant part of the world with the certainty that they would have before them a great future. He also endorsed the remarks of Mr. Pibel. The trawling industry had provided this country with such a defence as no other country in the world possessed.

Mr. R. R. Prynne said he had noted several points in the paper which, it seemed to him, would draw to a certain logical conclusion, but which, in the end, did not do so. The author had pointed out that the amount spent by our Government was about one-third the amount spent by the Canadian Government on fisheries; that many years ago certain rivers could produce great quantities of edible fish, but became polluted; and that in many cases experiments had been tried to repeople them, with perfect success; he had further pointed out that fishermen were a very valuable set of men; also that in many cases the prolificacy of fish round our sea-shores was hindered considerably by sea birds and other nuisances. Those points all seemed to him (the speaker) to draw to the conclusion that the Government of this country might do quite a great deal for fishermen, to the fact that State legislation was needed in order to fasten our fishermen more firmly to their native coasts, and that legislation should do something towards increasing fishermen's interests round the shores of Great Britain. But the author, after making all those points, had come to what seemed to him (the speaker) to be a most lame and impotent conclusion, namely, that the fishermen should be sent away to the other side of the world. He would venture to point out that if they did go to the other side of the world they would not be available to catch fish for the people of Great Britain; they would not defend our shores; they would not come back to their homes; in fact they would be lost altogether to this country, and would go somewhere where they would have to start catching fish all over again.

Mr. W. Simnett said he confessed he had been rather disappointed that no reference had been made to the work of the Fisheries' Organisation Society in particular. He thought one important question to be dealt with was in regard to the inshore fisheries of this country as affected by the conditions which would arise after the war. It had already been pointed out that the channels of distribution were somewhat drying up. That was an important point, because the central work of the Fisheries' Organisation Society was concerned with the organisation of fishermen in

co-operative societies, and their mainstay and greatest hope was in getting better markets for their fish. In that connection he desired to raise the point of the possibility of State action in increasing the channels of distribution and the markets for fish. The author had drawn an extremely attractive picture of the fishermen's Utopia abroad, but he (the speaker) thought that those who would be most drawn by the description would be the present fishermen rather than the returned soldiers and sailors. It was not to be desired that the present fishermen of this country should be attracted abroad.

DR. F. G. OGILVIE, C.B., thought that owing to an unfortunate omission at the beginning of his paper the author had created an impression which he had not intended. In the first place, the Department which was in charge of the fisheries of this country was the Department of Agriculture and Fisheries, and, while that was a single Department so far as representation in the Cabinet was concerned, it was a Department with two distinct staffs. One of these was specially charged with duties in relation to fisheries, and included men specially qualified for expert service in connection with fisheries. This fact rather bore on the points which had been referred to by previous speakers. It was a matter of common knowledge that the Government in recent years had been devoting a very great deal of attention to what it was best to do in order to promote the fisheries. They had not been prepared to cast gold upon the waters without consideration, and it might be they were taking longer time to think about it than people liked; but there was no doubt that the schemes now in hand involved sums considerably in advance of those quoted by the author. He would like to ask one question. He thought it was recognised that the author was asking the audience to look, not at the whole relation between the Government and the fishermen, but only at one particular aspect of the relation of the Government to fisheries. The paper in effect was a long suggestion that there was a possible outcome for valuable services in connection with fisheries elsewhere—an outlet for men who were not fishermen. But he must say that, having been a long time closely connected with fishermen, he had come to look upon fishing as being an occupation that had hitherto, at any rate, depended so largely upon traditional expertness, traditional familiarity with the sea and with fishing, and an early familiarity with the methods to be employed, that it was not the sort of occupation it would be wise to ask a grown man to take up, unless he had had some early experience which fitted him for it. Had the fisheries on the west coast of Canada features which made this unnecessary?

THE AUTHOR, in reply, said he was quite sensible of the advance in connection with ichthyology which the Department had made in the last few years. A very valuable amount of information had been collected, and our ichthyologists were second to none; and he should be very sorry if it went out that he was indifferent to the fostering care of the Government in the last ten years. Still, he thought it desirable there should be a separate Fisheries Department, with larger appropriations. In lobster hatching and lobster culture, the view of the professional mind in this country, as evidenced by Professor Macbride's remarks, was that the results from cultural operations were inadequate. All he could say was that in localities in Canada, or in the United States, where those operations were most extensively carried out, the fisheries seemed to be extremely prosperous, and the local community gladly accepted the taxes imposed for the purpose. The fact was, with regard to all Government departments, that a man of advanced age in any position of authority always fell in very slowly with any new experiments which some other country might be carrying out with great success, because it seemed to throw discredit on his past life's work that such experiments had not been attempted here earlier. With regard to Professor Macbride's criticism about the carriage of fish, the Grand Trunk system had made arrangements whereby every train running from Prince Rupert East had now one to six refrigerator cars carrying fresh fish. At the present moment London was receiving Prince Rupert halibut in good condition. It seemed to him that disabled soldiers and sailors would be quite equal to the work. It was the most unskilled labour in the world. It required no knowledge. Coming out of the harbour with Mr. Stewart, the contractor for the Grand Trunk Pacific Railroad, recently, that gentleman told him that one of his railwaymen had put a deep-sea line, with a number of hooks, in the sea overnight, and in the morning he pulled out 3,000 lbs. of halibut. Such fishing required no skill whatever. He had regarded the question of the national service which was being performed by our trawlers as outside the scope of the paper. He only treated a very vast problem from the point of view that we were threatened with a meat famine, and that the State should do everything to foster the fisheries and give a well-distributed fresh fish system, including fish from the Pacific Ocean.

On the motion of the CHAIRMAN, a vote of thanks was accorded to the author for his interesting and valuable paper.

TEA FROM NEW SOURCES.

The cultivation of tea, says the latest quarterly issue of the Bulletin of the Imperial Institute, has been attempted in a number of British possessions outside India and Ceylon, and notably in parts of Africa. The industry in Natal and Nyasaland has already been referred to in this Bulletin. Experiments in tea-growing have been made by the Department of Agriculture in the Southern

Provinces, Nigeria, and two samples of the product have been examined at the Imperial Institute: they proved to be of good quality. Samples of tea have also been received from Uganda, East Africa Protectorate, and Fiji, and these are dealt with as follows:—

UGANDA.

Tea-growing in Uganda is at present only in the experimental stage, two plots being grown at the Government plantation at Kampala. In the lower plot, situated near a drained swamp, the growth has been good, but in the other, at a higher level, the plants are stunted and make little or no progress. A sample of tea grown and prepared at Kampala was received at the Imperial Institute in November, 1913. It consisted of rolled black tea, dry and in good condition, but of somewhat uneven colour, a small quantity of light-coloured leaf being present. The tea was chemically examined, and the tests showed that when compared with the results obtained at the Imperial Institute for Indian and China teas the present sample of Uganda tea is rich in caffeine, tannin, and extractive matter, and that in this respect it resembles Indian rather than China tea.

The sample was submitted to a firm of brokers, who reported that it represented a blackish, rather bold and mixed, unassorted tea, with some white tip. The liquor was of fair strength, with some quality, but was very light in colour; and the infused tea, whilst generally of good colour, was uneven, with some greenish leaves. The brokers stated that the value of the tea was uncertain, but might be nominally about 8½*d*. to 9*d*. per lb. in London (January, 1914).

The brokers mentioned that this tea was very similar in style and appearance to a variety which used to be received from Java some years ago, called "Flowery Pekoe," but they added that the present sample had evidently not been graded. Compared with that of Indian, Ceylon, and Java teas, the liquor was in their opinion too thin to attract the competition of most buyers in London. They considered that the tea might with advantage be given a longer fermentation and also a heavier rolling, which would tend to increase the colour and strength of the liquor.

The firm added that the sample showed very fair manufacture, and if the suggestions made above were acted upon, they were of opinion that quite a satisfactory price would be realised in London, provided the tea came forward in marketable quantities of, say, not less than twenty chests at a time, each weighing 90 to 100 lbs. net, or twice the number of half-chests averaging about 50 lbs. net.

Two further samples of tea which had been fermented for a longer period than the previous sample were received from Kampala in January, 1914. They were as follows: No. 1, "Golden Tip"—dried, rolled tea, clean and in good condition, and varying from pale brown to black in colour, a large proportion of the paler leaf being present. No. 2, "Broken Leaf"—dried, rolled, black tea, mostly composed of broken leaf, and containing a small proportion of powder.

The teas, as received, were examined, and the result showed that when compared with the previous sample from Uganda, No. 1 contained a high percentage of caffeine. In other respects the tea is of normal composition, though the percentage of tannin is rather higher than usual. The analysis of sample No. 2 shows it to be of normal composition, and to resemble closely the previous sample of Uganda tea examined at the Imperial Institute, except as regards the percentage of tannin. The amount of this constituent appears to have been considerably increased by the longer fermentation to which the leaf had been subjected as compared with the previous sample.

The samples were submitted to a firm of brokers, who valued No. 1 at about 1*s*. 4*d*. and No. 2 at about 8*d*. per lb. in London (August, 1914). They added that the "Golden Tip" leaf, No. 1, was a somewhat fancy article which they considered could only be produced in small quantities. The firm stated that the longer fermentation to which these teas had been subjected, as compared with the earlier sample from Uganda, had resulted in some improvement in the colour of the liquor, but there is still a lack of strength in comparison with Indian and Ceylon teas. They suggested that this defect might be remedied by harder rolling.

EAST AFRICA PROTECTORATE.

Tea was first grown in the East Africa Protectorate on an estate at Limoru in 1904, from seed imported from India. The plants grew well, and localities similar to Limoru, where the rainfall is 60 inches or over in a normal year, and the air cool, seem well adapted for tea-planting. A sample of tea grown on this estate and prepared by hand was examined at the Imperial Institute in 1909. It was black tea of good aroma. The analysis showed that this tea from the East Africa Protectorate resembles Indian tea in the amount of extractive matter and tannin present, but that it contains an unusually high percentage of caffeine. The tea was submitted to a firm of brokers, who reported that it had, on the whole, been carefully prepared, that the twist of the leaf was good, but that the leaves were irregular in size, being unsorted. The liquor obtained on infusion was found to be of very fair quality, and the tea generally resembled that from several Ceylon gardens. The tea was valued at from 6½*d*. to 7*d*. per lb. (March, 1909). The investigation shows that tea of good saleable character can be grown in the Limoru district of the East Africa Protectorate with prospects of success.

FIJI.

A sample of tea, described as Orange Pekoe, from the Wainunu Estate, Fiji, was received for examination in July, 1909. It was a black tea, containing some tip, and was of fairly satisfactory appearance. The leaf was of a useful size, but somewhat broken. A chemical examination showed that the tea from

Fiji resembles the Indian teas in the percentage of tannin present, but that it contains a smaller amount of caffeine, agreeing in the latter respect with the China teas. The percentage of "extract" is between those given by the Indian and China teas. The firing of this tea appeared to have been carried out at rather too high a temperature, with the result that the sample smelt somewhat scorched. The infusion had but little strength, was light in colour, and tasted slightly burnt or "over-fired." The infused leaf was too dark and mixed.

The tea was submitted to commercial experts, who valued it at 7½d. per lb. (December, 1909). They stated, however, that this valuation was based almost entirely on the appearance of the tea. For the reasons already mentioned, the "liquor" was regarded as unsatisfactory, and in this respect the tea could only be classed with inferior descriptions. A better product would, no doubt, be obtained with more careful preparation.

NIGERIAN AND SOMALILAND LEATHER.

Nigerian leather has been exported to Europe and Asia from very early times, and it has always enjoyed an enviable reputation; but, in spite of this, practically nothing has hitherto been known about the methods in which the skins are prepared, tanned and dyed. Very considerable interest therefore attaches to an article on "Nigerian and Somaliland Leather," by Mr. Alfred Seymour-Jones, Chairman of the International Commission to investigate the preservation, cure, and disinfection of hides and skins, which appears in the *Leather Trades' Review*.

After describing the sources from which the skins are obtained—mainly sheep and goats—Mr. Seymour-Jones proceeds to discuss the preparation of Nigerian leather.

The methods of treatment followed by natives of West Africa, he says, agree in general principles but vary in details, according to the district. The operations divide themselves under the usual heads—(*a*) depilation, (*b*) bating, (*c*) tanning, (*d*) dyeing. The tools employed are crude, and the vessels are large earthenware pots. The tanning industry is widely distributed, and may be said to be almost a household occupation, but only in the sense of implying the extent to which the people follow that occupation and the relative smallness of each individual output.

On the skins being received from the local butcher they are in some instances washed, after which they are treated to an alkaline bath which compares with the modern method of liming. In some districts this bath is simply a mixture of wood ashes and water. According to Dr. Alexander, the Kanuri and Hausas, who are important producers of Niger leather, employ a strong alkaline preparation known as "toka," which consists of the ash obtained by burning the wood of the "Merki" (probably *Anogeissus leiocarpa*) or the "Anum" tree, or by burning the vegetable and other refuse from tanning and dyeing pits with wood from Merki, Anum, or Karumga (*Acacia Seyal*) trees.

A sample of "toka" has been analysed by the Imperial Institute with the following results :—

	Per cent.
Lime, CaO	18·45
Magnesia, MgO	2·93
Ferric oxide and alumina, Fe_2C_3 and Al_2O_3	7·79
Silica, SiO_2	69·96
Sulphate anhydride, SO_3	0·22
Phosphoric anhydride, P_2O_5	0·86
Carbon dioxide, CO_2	2·09
Water, H_2O	2·12

No organic matter was present, and the silica occurred almost entirely as sand. "Toka" is, therefore, very largely quicklime mixed with sand and other impurities, and its use as a depilatory corresponds with the similar use of lime in European tanyards.

The liming or depilatory process is carried through in the space of twenty-four hours, and the hair is scraped off with a blunt knife.

In the Ingra, Bobi and Kontagora districts of Northern Nigeria the depilation process assumes an interesting phase. Usually the skin is pegged and dried, yet it may be treated in the fresh condition. It is then placed in a calabash containing water and the powdered pods of an acacia, and left there for three days, after which it is removed, pegged out on a board and scraped with a bent knife until all the hair is taken off. The skin is then permitted to dry, and when finished is of a pearly white colour.

In consequence of the climatic conditions of West Africa, it is evident that some action other than alkaline plays the principal part in depilation. If similar skins were immersed in European lime liquors, they would take many days to depilate. It appears to be a clear case in favour of the bacterial theory as the chief agent in depilation. As the immersion accomplishes the act of depilation only and the skins are not returned to the lime liquor as is the case in Europe, the problem of swelling the skin in subsequent liquors in order to loosen the fibre plays no part. After depilation "they are allowed to dry for a day," when they are ready for bating. This repeated reference to drying appears to be the natives' method of sterilising the skin between operations while the skin is in the pelt condition.

For tanning purposes the chief agent throughout Nigeria are the pods of the *Acacia arabica*. The bark, which possesses a much lower tannin content, does not appear to be used. In Somaliland tanning is carried out entirely with the native tanning barks and leaves, and the

three commonly used for this purpose and recognised as the best are, in the order of their superiority, the leaves and tender young branches of the watta bush (*Osyris abyssinica*), the *thai*, or bark of the root of a species of acacia known as galol, and the bark of another acacia called marra.

The concluding section of the article deals with the dyeing of Nigerian leather, and describes the methods by which the natives obtain the beautiful reds and greens for which their leathers are famous.

THE PRODUCTION OF EAU-DE-COLOGNE.

One of the chief exports from the city of Cologne to France, Russia, England, and various other countries is eau-de-Cologne. It is also the most popular and most widely used perfume in Germany. There are two stories of the origin of eau-de-Cologne, one being that Giovanni Maria Farina, who was born in 1685, at Santa Maria Maggiore, Italy, first started its commercial manufacture, and the other that John Paul de Feminis, who lived near Santa Maria Maggiore and married into the Farina family, first made it. At any rate, several families named Farina lived at Santa Maria Maggiore and knew the secret of making perfumery, and the secret, according to a widespread tradition, was imparted to a member of the family by an Oriental. Eau-de-Cologne was first introduced into Cologne through some of the many Italians who opened shops there for the sale of Italian silks, embroideries, works of art, perfumery, etc. One or two of them were so successful in selling eau-de-Cologne, which at that time was called "Aqua della Regina," that they finally gave up their other interests and began manufacturing it in large quantities.

This was at the beginning of the eighteenth century, and, according to the United States Consul at Cologne, in 1740 one Farina opened a branch shop in Paris, where his perfume quickly became popular and acquired the name of eau-de-Cologne As the French Court at that time led the world in fashion, the name became valuable and was retained. So with the manufacturer's name, Farina. Many Italians, who had since become naturalised, at once turned their attention to the manufacture of eau-de-Cologne, and manufacturers who had no one named Farina in their family sent to Italy for a Farina, whom they made a partner, or else admitted into the firm some local man whose name was Farina, so that they could truthfully advertise eau-de-Cologne made by Farina. There are now forty manufacturers of the perfume in Cologne, and no less than twenty have the name Farina.

Until a few years ago there were bitter trade wars between manufacturers, some claiming that others were usurping their names or their label, or the form and shape of the bottle and the packing. This has now been stopped owing to the German law of registration of trade-marks, and each firm has its own distinctive label, even though many are very similar. It is impossible to state the yearly output of eau-de-Cologne. In Germany and France, among other countries, eau-de-Cologne is not only used as a perfume, but it is also believed to have some therapeutic effect in cases of inflammation of the eyes, headache, and toothache, and is even taken internally for indigestion and palpitation of the heart. It is largely used, too, sprinkled in baths and for refreshing the air in sick rooms.

There is no secret of the general process of manufacture. Eau-de-Cologne contains pure alcohol as a base, and from three or four to seven or eight other ingredients, which are essences of fruits and flowers. Lemons and oranges as well as their blossoms are always used, with, of course, other flower essences. Manufacturers state that even though quantitative and qualitative analyses should reveal the ingredients and their amounts, their perfumes could not be copied, as their virtue entirely depends upon the order in which the ingredients are put together. The formulæ of the different manufacturers are most jealously guarded, and only the head of each firm does the actual mixing, the secret being handed down from one generation to the next. The extracts and essences are bought in France and Italy, while the alcohol is manufactured in Germany. The best brands of eau-de-Cologne are stored for varying periods, so that the old bouquets or ethers can develop, just as they do in old wines. Manufacturers who make cheaper grades naturally cannot afford to keep large stocks, and their perfumes are, therefore, necessarily inferior. The general process of manufacture is simple, only a few assistants being needed, except for filling and labelling the bottles and packing. The bottles and corks, as well as the labels and packing materials, are made in Germany and bought from manufacturers.

THE DEVELOPMENT OF THE TEXTILE INDUSTRIES.

Industrial Habits.—The industrial habits of textile workers in general are distinctly good, and possibly for that reason very little is heard about them. It should, however, be noticed that nobody accuses any large number of them in the present jealously critical times of allowing drink to interfere with work. It is natural in this connection to assign some importance to the point that in the main industries about 60 per cent. of the employed are women, and some 15 per cent. are young persons in whom sobriety can be expected as a matter of course. Yet it cannot be said that the good record is dependent upon their influence or number. The departments staffed by women and young people are officered by men, and upon their punctuality and steadiness regularity and

efficiency depend. Then it is the case that good timekeeping is overwhelmingly the rule in the branches worked solely by men. Where irregularity is most marked there are familiar contributory circumstances. Where employment is intermittent, where men are engaged by the day or the half-day, and still more where they are engaged for the night, attendance at work is not uniformly good. The work of these casuals being unskilled, and sometimes unpleasant and exhausting, a certain irresponsibility is not to be wondered at. Relatively to the whole body these men are few, their employment is restricted to particular branches and districts, and their traditions are less respectable than those of the rest.

Women and Men.—The fact that men are the officers and non-commissioned officers of departments in which women and young people form the rank-and-file has its importance in another connection. Those managers, overlookers, and loom-tacklers could not be removed bodily into military training without throwing the employment of women into chaos. Their functions are in part executive, but it can hardly be said that there are women ready equipped to take over that part of the duty. Some of the tasks involve bodily strain, as in the setting of machines, although the exertion is not always severe. The visibly effective barrier to the substitution of women for men in these posts is a twofold one. A nice understanding of machinery is required, such as is to be obtained only by experience; and the women in closest contact with the machines are generally ill-educated and without mechanical knowledge or knack. These may be the reasons why women have scarcely displayed so much as a symptom of ability to replace men in the higher branches of mill work. Men adjust the machines which women mind, but there are also male machine-minders—for example, weavers—employed mainly on heavier or more complicated work than that done by women. In many mills there are employments which are men's jobs rather by custom than by necessity, and in a few of them men have ousted women, although usually the process has worked the other way about. These considerations, complicated by union rules and employers' preferences, make the drafting of men out of industrial occupations into military work one of some considerable difficulty, and necessitate the conferences that are now being held in which employers, operatives, and Government officials are taking part.

The Natural Dyes.—The imminent shortage of dyestuffs begins to weigh more heavily on the minds of dyers, but it is not clear that the prospects have done much to stimulate sales of white or cream-coloured goods for the summer. Larger quantities than usual of the old-fashioned dyewoods and extracts are palpably being used, but the increase upon this hand does not compensate for the decrease in the receipts of the artificial colours. Evidently there are still misapprehensions abroad as to the relative merits of such dyes as can be extracted from plants and the coal-tar colours. A recent question in Parliament spoke of the former as fast and superior, but these are not claims that can be maintained. The natural colours are in general less bright than the artificial, but nothing is easier than to sadden a bright colour to any desired degree of dullness. The advantage of fastness lies incontestably with the artificial colours, but in the eyes of any dyer the supreme advantage of the latter consists in their ease of application and the certitude with which a required shade can be produced. Leaving aside the cost of the colour stuff, the cost of applying the tar dye is enormously less, and, apart from any other consideration, this suffices to put several theoretically eligible materials altogether out of practical account

Swiss Patent Law.—The normal output of the Swiss colour factories is calculated to be about one-twelfth of the German. Evidently they delivered little to this country during March, and, indeed, the total receipts of foreign tar dyes during this year average only the small amount of ninety tons per month. The obtaining of Swiss supplies is understood to be contingent in part upon the supply of intermediate products from this country. Apart from the temporary aspect, it is pertinent to inquire why a small country with a small internal consumption of colours has a relatively large colour-making industry; all the more so because larger countries with larger needs have failed to acquire a colour industry of any appreciable size. It is, perhaps, not generally known that, until a few years ago, nothing was patentable in Switzerland which could not be represented by a model. In effect there were no patents obtainable for chemical processes or products, and there was consequently nothing to stop Swiss manufacturers from making use of any processes of which they could gain particulars. The hiatus had its useful results, but it is to be inferred that also it had its disadvantages. At any rate, Swiss law was amended to make the patenting of processes and products practicable.

German Substitutes.—The trouble of getting a sufficiency of jute fabric has led the British Government to adopt a coarse cotton cloth for the making of sandbags. Cotton canvas has in several directions been substituted for flax, and with the variety and quantity of fibres at disposal there need be no doubt that all requirements can be effectively met. A German journal shows that the enemy is using "*Stranfa*"—a product of straw—in place of jute for forage

bags, but the substitute does not serve for meal, presumably because the powder leaks through the interstices. The German civil public has been adjured to use the same material as far as possible. The substitute is clearly only a partly efficient one, like the other German substitutes that have been tried. It may be recalled that German sacks, made half of jute and half of twisted paper, were responsible for the bursting loose of a whole ship's cargo not many years ago. For reasons not specifically stated, the German Association of Hemp Manufacturers have given a conditional guarantee to buy all the hemp that farmers in Germany can produce, and they have undertaken to sell seed to the growers at about half the market price. The German cotton-finishing industries have been placed in an awkward position by the refusal of the Government to allow starches to be used for the stiffening of cloth.

The Transference of Business.—The worsted industry is experiencing marked benefit from the cessation of Continental competition. Orders are being received for large quantities of the dry-combed merino tops which are one of the special products of the German combing mills; for merino yarn that would normally have been bought from Germany; and for merino dress goods. In a less direct manner the sale of such British specialities as mohair and alpaca is being stimulated. By the time that military requirements have been met to the full the embargo upon the export of the stronger wools and the yarns made from them should be removed. When that obstacle is out of the way a strong impetus to the sales of the prime British speciality ought to follow. A continually increasing proportion of woollen and worsted machinery is being diverted to private trade, and although the profits of trading are nothing like equally distributed, the prospects may be regarded as good.

An Industrial Guide.—The chances are that any set of data compiled for his own reference by one man would have their utility to a considerable number of others. A pocket-book, preserving facts and figures for reference, was the foundation of Mr. S. Ecroyd's "Cotton Year Book" (Marsden, Manchester, 2*s.* 6*d.*), now in its tenth year of issue. The contents have less to do with raw cotton and cotton movements than the title might seem to suggest, although the operations of the cotton market are very lucidly described. The main preoccupation is with the machines on which cotton is manufactured, and their functions, features, systems, and relations one to another are set forth most systematically. The outcome is a kind of *catalogue raisonné*, a catalogue of no one firm, embracing impartially virtually every machine used for cotton. For ready reference such a book is both handier and less confusing than treatises in which the intricacies are explored at more length, and of essential practical matter it contains as much as a shelf of books, with the advantages of a compact form and an orderly arrangement. Perhaps "Guide Book" would be a more correct name for it than "Year Book," and to all the highways and most of the byways, and to most of the surrounding country, the volume makes a valuable and unique guide.

OBITUARY.

Sir James Rankin, Bt.—The death of Sir James Rankin took place at his residence at Bryngwyn, Herefordshire, on the 19th inst. He was born in 1842, and was educated at Trinity College, Cambridge, where he obtained a first class in the Natural Sciences Tripos. He entered the House of Commons in 1880, as Conservative M.P. for Leominster; the borough was disfranchised by the Reform Bill in 1885, and from 1886 to 1906, and again from 1910 to 1912, he represented North Herefordshire. He was created a baronet in 1898. For some years, 1877–84, he was Master of the South Herefordshire Hounds.

Sir James took a deep interest in various social questions, and published papers on Old Age Pensions, Housing of the Poor, and kindred subjects. In 1883 he read a paper on "The Duty of the State towards Emigration," for which he received the Society's silver medal. He became a member of the Royal Society of Arts in 1877.

Sir Charles Seely, Bt.—Sir Charles Seely died suddenly from heart failure, after an attack of influenza, on the 16th inst., at his residence, Brooke House, Isle of Wight.

He was born in 1833, the son of the late Mr. Charles Seely, a well-known coalowner and for many years Liberal member of Parliament for Lincoln. Sir Charles was elected M.P. for Nottingham in 1869, and continued as one of the representatives of the constituency till 1874, and again for the periods 1880–85 and 1892–95. After the introduction of the Home Rule Bill, he was among the Liberal members who seceded.

Sir Charles was a keen supporter of the Volunteer movement, and for eighteen years was Colonel of the Robin Hood Rifles. He was created a baronet in 1896. He was a generous benefactor to Nottingham, and also to the Isle of Wight, where he was a large landowner. His third son, Brigadier-General John Seely, was for some years Secretary of State for War.

Sir Charles was elected a member of the Royal Society of Arts in 1871.

NOTES ON BOOKS.

The Indian Year Book, 1915. Edited by Stanley Reed, LL.D. London, Bombay, and Calcutta: Bennett, Coleman & Co., Ltd.

When this "Whitaker of India" made its first appearance last year it received a warm welcome, and a large edition was exhausted within three months. There can be little doubt that this welcome will be extended to the second issue, and that the better it becomes known the wider and deeper will be the public appreciation of it. For it contains an immense mass of information, not readily obtainable from other sources, dealing with all aspects of Indian life.

The principal new feature of the second issue is a review of the proceedings of the Legislative Councils. In the case of the Imperial Legislative Council this has been made as complete as possible, and covers eleven pages of very small type; the accounts of the Provincial Councils are naturally briefer. The splendid part which India has played in the great war is also well described in a special article, and the volume is enriched by an excellent map of the Indian Empire.

It is quite impossible within reasonable limits to give any account of the multifarious subjects treated in the Year Book. Suffice it to say it is packed full of information which should prove of great service to politicians, statisticians, geographers, economists—indeed, to all who take an interest in India; and it should find a place along with the classic works of reference in every club and public library.

GENERAL NOTES.

Professional Classes War Relief Council.—A grand patriotic concert will be given at the Royal Albert Hall to-morrow afternoon (the 24th inst.) at 3 p.m. in aid of the funds of this council and of the Lord Mayor's recruiting bands. Among the artists will be Miss Ruth Vincent, Miss Lily Elsie, Madame Kirkby Lunn, Mr. Ben Davies, and Madame Tita Brand. The massed recruiting bands and the Coldstream Guards' band will also play.

Chinese Conservancy Engineering College.—An institution has been established at Nanking for the study of conservancy engineering. It is under the control of the National Conservancy Bureau, and its expenses are paid by the provinces of Chihli, Shantung, Kiangsu, and Chehkiang. The school has as its object to train engineers for conservancy work. The whole course covers four years—one year in the preparatory school and three years in the college. For the purpose of meeting requirements for the conservancy work of the Huai River a special course is given. This course covers two years of the study of important subjects. The requirements for entrance examination are Chinese essay, English, algebra, plane and solid geometry, chemistry, and physics. With the exception of the students coming from the four provinces supplying funds to the institution, those who come from the other provinces will have to pay a yearly tuition fee of $40 in addition to boarding expenses. Students after graduation are liable to serve a certain period in the National Conservancy Bureau.

The World's Shipbuilding.—According to the annual summary issued by *Lloyd's Register of Shipping*, during 1914, 656 vessels, of 1,683,553 tons gross, were launched in the United Kingdom. The output of mercantile tonnage shows a decrease of 248,600 tons on that of the previous year, which was the highest ever reached. Of the total output, 75⅝ per cent., or 1,273,530 tons, has been built for registration in the United Kingdom. The amount of tonnage launched for other countries during 1914 was 410,023 tons, forming 24⅓ per cent. of the total output, as compared with over 21½ per cent. in 1913, nearly 24 per cent. in 1912, 22⅓ per cent. in 1911, 19½ per cent. in 1910, 24⅔ per cent. in 1909, 40 per cent. in 1908, and 34 per cent. in 1907. The Clyde district occupies the first place among the shipbuilding centres of the country, showing an output of 444,621 tons (Glasgow 288,103 tons and Greenock 196,518 tons). Then follow the Tyne (315,585 tons), the Wear (277,528 tons), Belfast (239,819 tons), Middlesbrough (137,165 tons), and Hartlepool (124,419 tons). Of the vessels launched in the United Kingdom during the year, two steamships, with a total tonnage of 13,618 tons, were built for Japan, against one vessel in each of the two preceding years. With regard to the output of other countries, it is noted that the tonnage launched in Japan during the year (85,861 tons) is nearly 33 per cent. higher than the output for 1913, and exceeds all previous totals. It comprises three steamers of between 11,000 and 12,000 tons each, and one steamer of 7,345 tons, fitted with geared turbine engines. The remainder of the total is composed of vessels of small tonnage, of which 26 vessels (51,038 tons), were built at Kobé and Osaka, five vessels (32,623 tons) at Nagasaki, and one (2,200 tons) elsewhere in Japan.

Ground-nuts.—Under the auspices of the Imperial Institute serious attempts are being made to create a market in this country for the ground-nuts grown in India and the British Colonies, such as Gambia and Nigeria, and inquiries are invited for information on the culinary uses to which they can be put. As a food for cattle, the flesh-forming value of the ground-nut has long been recognised, but in this country, at all events, it has not been seriously considered as an article of food. In the United States of America the nuts are eaten roasted, as well as in the form of "pea-nut butter," a paste made by grinding the blanched kernels. In West Africa the kernels are regularly used as a vegetable, chiefly in the form of soup, though they are also served in a variety of other ways, and in France a good deal of what is sold as olive oil really hails from South Indian ground-nuts.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock:—

April 28. — A. S. E. Ackermann, B.Sc. (Engineering), Assoc.M.Inst.C.E., "The Utilisation of Solar Energy." Charles Vernon Boys, F.R.S., will preside.

May 5. — Augustus Vernon Harcourt, D.C.L., LL.D., D.Sc., F.R.S., "On the Measurement of the Efficiency of Domestic Fires, and on a Simple and Smokeless Grate." Francis William Goodenough, M.Inst. Gas Engineers (Gas Light and Coke Co.), will preside.

May 12.—Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry." Sir Robert Abbott Hadfield, D.Sc., F.R.S., will preside.

Additional Lecture.

Thursday afternoon, at 4.30 o'clock:—

May 6.—M. Paul Lambotte, Directeur des Beaux-Arts au Ministère des Sciences et des Arts de Belgique, "Constantin Meunier et les Sculpteurs Belges de son Temps." Lord Sanderson, G.C.B., K.C.M.G., will preside.

Indian Section.

Thursday afternoon:—

May 13, at 4.30 p.m.—Sir Charles H. Armstrong, late Chairman, Bombay Chamber of Commerce, "Indian Trade and the War." The Most Hon. the Marquess of Crewe, K.G., P.C., Secretary of State for India, will preside.

Colonial Section.

Tuesday afternoon, at 4.30 o'clock:—

May 4.—S. Chas. Phillips, M.S.C.I., "The Empire's Resources in Paper-making Materials." The Hon. Sir George H. Perley, K.C.M.G., Member of the Canadian Government, will preside.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

David Sommerville, B.A., M.Sc., M.D., M.R.C.P., D.P.H., Assistant Professor of Hygiene and Public Health, University of London, King's College, "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

Syllabus.

Chemical Constitution of Foodstuffs—Proteins—Carbohydrates — Fats — Inorganic Substances — Colloids and Crystalloids—Metabolism—Enzymic Action in the Alimentary Canal.

MEETINGS FOR THE ENSUING WEEK.

Monday, April 26...Royal Society of Arts, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Dr. D. Sommerville, "Foodstuffs." (Lecture I.)

Medicine, Royal Society of, 1, Wimpole-street, W. Section of Odontology, 8 p.m. 1. Discussion on Dr. E. Waller's paper, "The Influence of the Thyroid Gland on Dental Caries." 2. Dr. J. S. Wallace, "The Principles of Dietetics."

Surveyors' Institution, 12, Great George-street, S.W., 8 p.m. Discussion on paper by Messrs. C. S. Joseph and R. S. Gardiner, "The Report of the Land Enquiry Committee on Housing."

Geographical Society, Burlington - gardens, W., 8.30 p.m. Mr. D. G. Hogarth, "Geography of the War in the Near East."

Actuaries, Institute of, Staple Inn Hall, Holborn, W.C., 5 p.m. Mr. G. King, "The New National Life Tables."

Tuesday, April 27...Sociological Society, at the Royal Society of Arts, John-street, Adelphi, W.C., 5.15 p.m. Mr. G. P. Gooch, "German Theories of the State."

Illuminating Engineering Society, at the Royal Society of Arts, John-street, Adelphi, W.C., 8 p.m. Messrs. C. C. Paterson and B. P. Dudding, "Visibility: its Practical Aspect."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. B. Fletcher, "The War on Belgian Architecture." (Lecture III.)

Civil Engineers, Institution of, Great George-street, S.W., 8 p.m. Annual General Meeting.

Photographic Society, 35, Russell - square, W.C., 8 p.m. Mr. E. Marriage, "The Carvings on Amiens Cathedral."

Electrical Engineers, Institution of (Local Section), 17, Albert-square, Manchester, 7.30 p.m. Mr. A. Dickinson, "The Bombay Hydro-Electric Scheme."

Zoological Society, Regent's-park, N.W., 5.30 p.m. 1. Mrs. Rose Haig Thomas, "White Collar Mendelising in Hybrid Pheasants." 2. Mr. E. G. Boulenger, "On Two New Tree-Frogs from Sierra Leone, recently living in the Society's Gardens." 3. Messrs. E. Heron-Allen and A. Earland, "The Foraminifera of the Kerimba Archipelago (Portuguese East Africa." (Part II.)

Wednesday, April 28...Royal Society of Arts, John-street, Adelphi, W.C., 8 p.m. Mr. A. S. E. Ackermann, "The Utilisation of Solar Energy."

Electrical Engineers, Institution of (Local Section), The University, Birmingham, 7.30 p.m. Mr. A. Dickinson, "The Bombay Hydro-Electric Scheme."

Sanitary Institute, 90, Buckingham Palace-road, S.W., 5 p.m. Dr. W. P. Norris, "The Evolution of Hygiene and Public Health in Australia."

Thursday, April 29...Royal Society, Burlington House, W., 4.30 p.m.

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Royal Institution, Albemarle - street, W., 3 p.m. Dr. A. W. Porter, "Advances in General Physics." (Lecture I.)

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mr. E. Marriage, "Amiens Cathedral."

Electrical Engineers, Institution of, Victoria-embankment, W.C., 8 p.m. Mr. A. Dickinson, "The Bombay Hydro-Electric Scheme."

Friday, April 30...Petroleum Technologists, Institution of, at the Royal Society of Arts, John-street, Adelphi, W.C., 8 p.m. Mr. W. Calder, "Oil Well Engineering."

Royal Institution, Albemarle-street, W., 9 p.m. Professor F. G. Donnan, "Emulsions and Emulsification."

Saturday, May 1...Royal Institution, Albemarle-street, W., 3 p.m. (Tyndall Lecture.) Professor J. A. Fleming, "Photo-Electricity." (Lecture I.)

5 p.m. Annual Meeting.

Journal of the Royal Society of Arts.

No. 3,258. VOL. LXIII.

FRIDAY, APRIL 30, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MAY 3rd, 8 p.m. (Cantor Lecture.) DAVID SOMMERVILLE, B.A., M.Sc., M.D., M.R.C.P., D.P.H., Assistant Professor of Hygiene and Public Health, University of London, King's College, "Foodstuffs." (Lecture II.)

TUESDAY, MAY 4th, 4.30 p.m. (Colonial Section.) S. CHAS. PHILLIPS, M.S.C.I., "The Empire's Resources in Paper-making Materials." The HON. SIR GEORGE H. PERLEY, K.C.M.G., Member of the Canadian Government, will preside.

WEDNESDAY, MAY 5th, 8 p.m. (Ordinary Meeting.) AUGUSTUS VERNON HARCOURT, D.C.L., LL.D., D.Sc., F.R.S., "On the Measurement of the Efficiency of Domestic Fires, and on a Simple and Smokeless Grate."

THURSDAY, MAY 6th, 4.30 p.m. (Special Lecture.) M. PAUL LAMBOTTE, Directeur des Beaux-Arts au Ministère des Sciences et des Arts de Belgique, "Constantin Meunier et les Sculpteurs Belges de son Temps." LORD SANDERSON, G.C.B., K.C.M.G., will preside.

Further particulars of the Society's meetings will be found at the end of this number.

HONORARY ROYAL FELLOW.

The Council have the pleasure of announcing to the Fellows that His Majesty the King of the Belgians has graciously consented to allow his name to be added to the List of Honorary Royal Fellows.

His late Majesty King Leopold was one of the first two Honorary Royal Fellows elected in 1876, the other being His late Majesty the King of Sweden and Norway.

The other Royal Honorary Fellows of the Society are: The King of Spain (1905), The King of the Hellenes (1906), The King of Norway (1906), The King of Sweden (1908), The King of Portugal (1909), The Emperor of Russia (1909), and The King of Denmark (1914).

CANTOR LECTURES.

On Monday evening, April 26th, DR. DAVID SOMMERVILLE, B.A., M.Sc., M.R.C.P., D.P.H., Assistant Professor of Hygiene and Public Health, University of London, King's College, delivered the first lecture of his course on "Foodstuffs."

The lectures will be published in the *Journal* during the summer recess.

PROCEEDINGS OF THE SOCIETY.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 28th, 1915; CHARLES VERNON BOYS, F.R.S., in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Balls, William H., Southern High School, Broad and Jackson-streets, Philadelphia, Pennsylvania, U.S.A.

Heath, Principal Lionel, I.E.S., Mayo School of Art, Lahore, Punjab, India.

Lau Chu Pak, Hon., J.P., 1, Babington-path, Victoria, Hong-Kong, China.

Stanley, William, Great Barrington, Massachusetts, U.S.A.

Turner, Walter V., Edgewood Park, Pittsburgh, Pennsylvania, U.S.A.

The following candidates were balloted for and duly elected Fellows of the Society:—

Best, William Newton, M.Am.S.Mech.E., 11, Broadway, New York City, U.S.A.

Higman, Ormond, M.I.E.E., Electrical Standards Laboratory, Ottawa, Canada.

Jairazbhoy, Cassamally, Warden-road, Bombay, India.

Khan, Sahebzada Abdussamad, C.I.E., Chief Secretary, Rampur State, Rampur, United Provinces, India.

Mellor, Alfred, 152, West Walnut-lane, Germantown, Philadelphia, Pennsylvania, U.S.A.

Ram, Atma, Civil Lines, Ludhiana, Punjab, India.

Rumbough, John B., Enterprise Machine Company, 67–71, North Main-street, Asheville, North Carolina, U.S.A.

Smith, Miss Alice Maude, M.D., Chicago State Hospital, Dunning, Illinois, U.S.A.

Wilder, Gerrit Parmile, care of Hawaiian Trust Company, Ltd., Honolulu, Hawaii.

Wilder, Leonard H., Ingleside, near McLean, Virginia, U.S.A.

The paper read was—

THE UTILISATION OF SOLAR ENERGY.*

By A. S. E. Ackermann, B.Sc. (Engineering), A.C.G.I., M.Cons.E., A.M.Inst.C.E.

As it has been justly said that the play of "Hamlet" without the Prince of Denmark is somewhat dull, perhaps it will be well to devote a few words to the principal actor in all schemes for the utilisation of solar energy, viz., the sun. He is no longer regarded as a monster fire, burning in the manner of fires in our grates. Great as is his mass, it would be comparatively rapidly consumed if such combustion were taking place. Another reason why this old idea was given up is, that the temperature of the sun has been determined by several experimenters, and all agree that it is about 6,000° C. This is far too high to permit of the formation of most chemical compounds, and for the production of heat by combustion it is necessary for such compounds to be formed. Briefly, such a temperature decomposes nearly all compounds into their elements and prevents their re-uniting and the consequent production of heat.

Scientists are by no means certain how the sun's heat is produced, but one theory is that it is due to radio-activity, and another, due to Helmholtz, that the energy to keep up the radiation could be supplied by a relatively microscopic contraction of the sun's volume, though even this theory is not a complete success, as it implies that the age of the sun is 17,000,000 years. Great as is this lapse of time, geology indicates that our earth is considerably older; but as the earth cannot very well be older than the sun, we must conclude that the sun is older than 17,000,000 years.

As to what the structure of the sun is, there is also doubt; but the inner portion is spoken of as the nucleus, and the outer portion as the atmosphere, and as the outer layers of the atmosphere get relatively cooled they sink to a lower level, and their place is taken by hotter layers. Thus there is a continual circulation of the sun's atmosphere.

The specific gravity of the sun is only about a quarter of that of the earth, whose specific gravity is 5·53. A cubic foot of water weighs 62½ lb., and hence an average cubic foot of the sun weighs 86¼ lb., while an average cubic foot of the earth weighs 345 lb. For comparison, it may be mentioned that a cubic foot of granite weighs 165 lb. The density of the sun being so small, it is concluded that it can still go on contracting, and hence that it is probably getting hotter instead of cooler, as is popularly supposed. If this be so, it is a hopeful feature for future workers in the field of solar energy.

The diameter of the sun is 863,600 miles, or about one hundred times the diameter of the earth, and an earthly pound weight at its surface would weigh 27½ lb. The glowing surface which the sun presents to us, even considering him as a flat disc, has the enormous area of 585,750,000,000 square miles, each square foot of which emits the enormous amount of about 12,500 h.p., and the radiant energy received at the outer surface of the earth's atmosphere is equivalent to 7,300 h.p. per acre. Of this about 70 per cent. (say, 5,000 h.p. per acre) is transmitted to the land surface of the earth at noon on a clear day, and less in the morning and evening, owing to the greater thickness of atmosphere through which the radiation has to pass.

The quantity of solar heat per unit area which arrives in unit time at the outer surface of our atmosphere is called the solar constant, and its value, as determined in 1913 by C. G. Abbot, of the Smithsonian Institution, after making 696 experiments in different parts of the globe, is 1·93 calories per sq. cm. per min. (= 7·12 B.T.U. per square foot per minute). Its value given by various experimenters between 1881 and 1909 was considerably higher, and this makes it all the more remarkable that John Ericsson, the engineer and inventor who spent some £20,000 on experiments with solar energy, when writing in 1876 a record of his life's work, gave the value of the solar constant as 7·11 B.T.U. per square foot per minute, and said, "In view of the completeness of the means adopted in measuring the energy developed, and the

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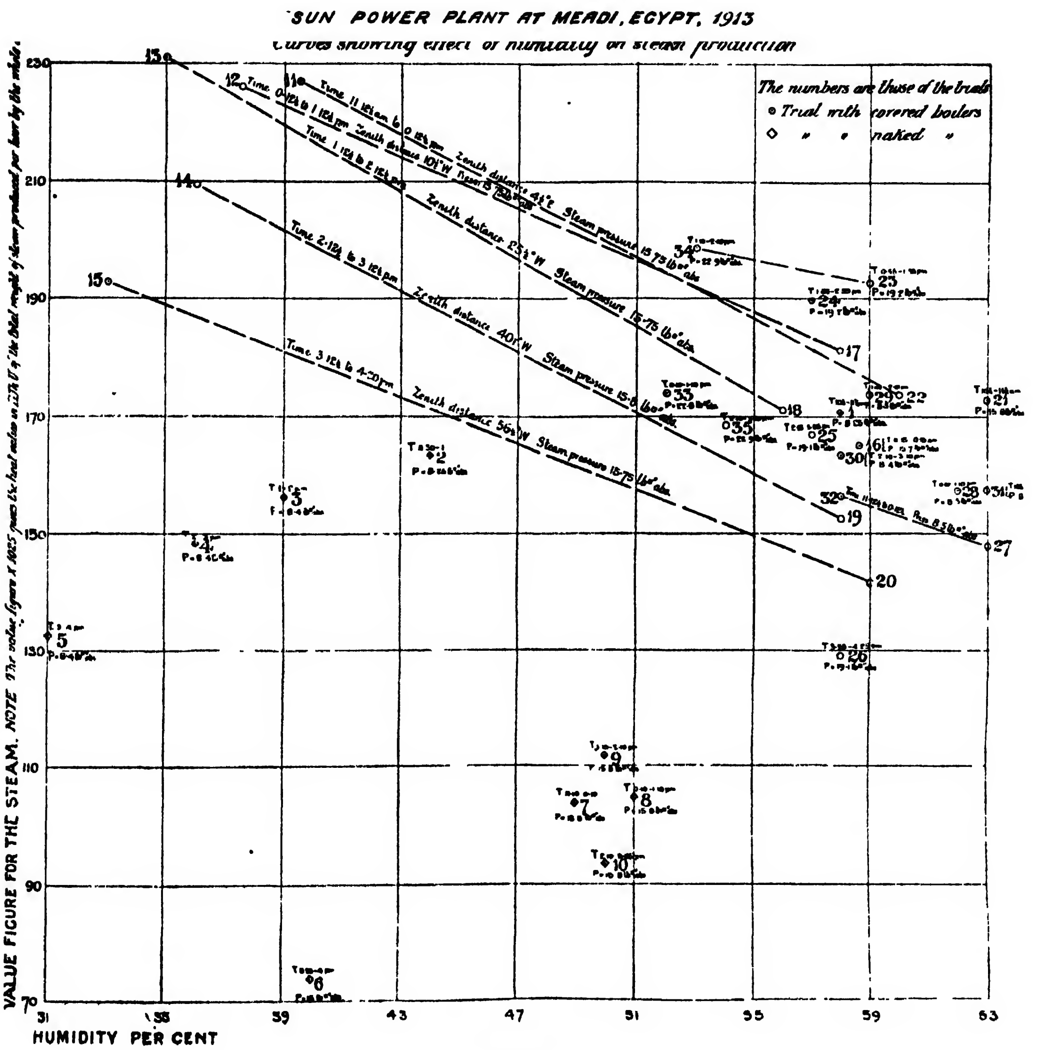

FIG. 1.

ample time which has been devoted to the determination of the maximum intensity, it is not probable that future labours will change the result of our determination," and, as shown above, his confidence was justified.

Perhaps the most remarkable things about solar radiation are that it passes through the 93,000,000 miles (one million is 2,740 a day for a year) of space between the sun and the earth, the temperature of which is nearly absolute zero (*i.e.*, it is about $-263°$ C.), and that only three-fifths of it produces any impression on the eye. It is not till the radiant energy impinges on some material body that it is converted into heat. The best body for causing such conversion is a dead-black one.

The absorption of solar energy by the atmosphere is about 20 per cent. greater in summer than in winter. This may be due to there being a larger total quantity of water vapour in the atmosphere in summer than in winter. It has long been known that the greater the humidity of the atmosphere the greater the amount of heat stopped by it; but the author believes that his experiments in Egypt in 1913, with the Shuman-Boys sun-power plant, were the first which determined the quantitative effect of humidity, especially on so large a scale. The curves on Fig. 1 record the results, from which it is seen that when the humidity decreased 20 per cent. the quantity of steam increased about 30 per cent., thus showing the great importance of humidity in connection with this subject.

The great possibilities of this field of work, and the obvious fact that there is a limit to our supplies of coal and oil, have naturally attracted many workers, of whom the following is a chronological list. Some of them, however, have not been engaged in the practical utilisation of solar energy, but in determining the solar constant and atmospheric absorption which tell us the theoretical quantity of heat available for power purposes.

Name.	Date of Birth.	Date of Death.	Date of first Solar Work.
Solomon de Caux (France)	1576	1626	1615
H. B. de Saussure (Sweden)	1740	1799	1766
Sir John Herschel (England)	1792	1871	1836
C. S. M. Pouillet (France)	1791	1868	1838
C. L. Althans (Germany)	(?)	(?)	1853
Carl Güntner (Austria)	(?)	(?)	1854
August Mouchot (France)	(?)	(?)	1860
John Ericsson (U.S.A.)	1803	1889	1864
C. H. Pope (U.S.A.)	(?)	(?)	1875
William Adams (England)	(?)	(?)	1876
Abel Pifre (France)	(?)	(?)	1878
S. P. Langley (U.S.A.)	1834	1906	1881
J. Harding (England)	(?)	(?)	1883
Chas. Louis Abel Tellier (France)	(?)	1913	c. 1884
A. G. Eneas (U.S.A.)	(?)		1900
H. E. Willsie	(?)		1902
C. G. Abbot (U.S.A.)	1872		1905
Frank Shuman (U.S.A.)	1862		1906
Ch. Féry (France)	1865		1906
G. Millochau (France)	1871 (?)		1906

Now, although the theoretical power value of the heat reaching the surface of the earth is no less than 5,000 h.p. per acre, it must not be thought that anything like this amount can be converted into mechanical power, any more than can all the heat of coal be converted into its theoretical equivalent of mechanical power. For example, the heat value of good coal is about 14,500 B.T.U. per lb. = 12,760 h.p. hours per ton, but in fact the best result, even under test conditions, ever obtained from a ton of coal by means of a boiler and steam engine is only about 1,470 b.h.p. hours, or 11·5 per cent. of the heat value, while in the case of a gas engine the corresponding figure is 25·5 per cent., and of a Diesel oil engine 31 per cent. The chief loss is in converting the steam into mechanical energy, and most of the loss is inevitable for thermodynamic reasons. With this fact in mind, you will not be so surprised to learn that the best overall thermal efficiency obtained from the Shuman-Boys plant in Egypt was only 4·32 per cent., the chief reasons for this being so much less than 11·5 per cent. being that the steam pressure was so low, and that the best efficiency of the sun-heat absorber was only 40·1 per cent., compared with 75 per cent. for the best coal-fired boiler. But it has taken boilermakers many years to attain this efficiency, so that 40·1 per cent. is not a bad result when the number of sun-boilers that have been made is taken into account. Thermal efficiencies of engines are materially affected by the heat-fall of the steam, just as the efficiencies of water

turbines are affected by the height of the waterfall. The larger the fall in either case the better the efficiency.

It is interesting to realise from the foregoing figures that the value of 2½ acres of bright sunshine for an hour is one ton of coals. This fact is more readily realised in Egypt in the summer. With this we may compare what Mr. J. C. Hawkshaw said in his presidential address to the Institution of Civil Engineers in 1902, viz., that the wood fuel produced by an acre of land in Europe is equivalent to at least one ton of coal a year.

With so much heat generated at the surface of the earth it might be thought that the temperature of the earth would rise. So it would do, were it not for the fact that the earth radiates into space as much heat as it receives, though some of it may be stored on earth for a time in the form of vegetable growth (including coal) or water raised to high levels.

Coal has been called "bottled sunshine," but the cork of the bottle must be a leaky one, for Abbot says ("The Sun," p. 360): "It appears from such investigations as have been made that plants may store up as chemical energy in round numbers 1 or 2 per cent. of the energy of solar radiation which shines upon their leaves." With regard to the earth's own heat, it has been estimated that the continuous supply coming from the interior to the surface is equivalent to 1,280 h.p. per square mile, or only 2 h.p. per acre.

Having now considered the nature of the source and the quantity of heat available, we will give a brief description of the plants which have been constructed by various experimenters for the purpose of utilising solar heat. They are given in chronological order as regards their solar work so far as the author has been able to discover the facts.

At one stage the author thought he had discovered the earliest worker at the subject when he came across a record of Sir John Herschel's experiments in 1836, but further research disclosed that Buffon, the celebrated French naturalist, was at work in 1747, and on April 10th of that year he succeeded in setting fire to a plank of tarred wood, at a distance of 150 ft., by solar rays reflected from a combination of flat mirrors. He did this to show the possibility of the legend that Archimedes set fire to the fleet of Marcellus at Syracuse in 212 B.C.

Other early workers were Roger Bacon, an English Franciscan monk, who died in 1294; Solomon de Caux (1576–1626), a French engineer, who in 1615 invented and described the first machine for raising water by solar heat and the expansion of air; Ducarla; and H. B. de Saussure, the Swiss geologist, physicist, and naturalist, who made (in 1787) the second ascent of Mont Blanc. To de Saussure the credit is due for inventing the "hot box" (*i.e.*, an insulated air-tight wooden box, black inside, and covered with two layers of plain glass with an air space between them), which has since been such a favourite with other workers. It was he, too, who found that a cover of two sheets of glass gave the best results.

Next in the field was Sir John Herschel, F.R.S., who in 1837 took the temperature of the surface soil near Cape Town, and for dry earth recorded temperatures varying from 120° F. to 162° F., the latter having been obtained on December 1st, 1837, at 0.36 p.m., in a sand heap sheltered from the wind in a small garden enclosure, the soil being moist 3 ins. or 4 ins. below the surface.

He also experimented with "a small mahogany box, blackened inside, covered with window-glass fitted to size, but without putty, and simply exposed perpendicularly to the sun's rays." In this box he recorded a temperature of 152° F., but "when sand was heaped round the box to cut off the contact of cold air, the temperature rose on December 3rd, 1837, to 177° F. And when the same box, with its enclosed thermometer, was established under an external frame of wood well sanded up at the sides, and protected by a sheet of window-glass (in addition to that of the box within), the temperatures attained on December 3rd, 1837, were—

Time.	Temperature.
1.30 p.m.	207·0° F.
1.50 „	217·5
2.44 „	218·0

and that with a steady breeze sweeping over the spot of exposure. Again on December 5th, under a similar form of exposure, temperatures were observed—

Time.	Temperature.
0.19 p.m.	224° F.
0.29 „	230
1.15 „	239
1.57 „	248
2.57 „	240·5

"As those temperatures far surpass that of boiling water, some amusing experiments were made by exposing eggs, fruit, meat, and in the same manner (December 21st, 1837, *et seq.*), all of which, after a moderate length of exposure, were found perfectly cooked—the eggs being

rendered hard and powdery to the centre; and on one occasion a very respectable stew of meat and vegetables was prepared, and eaten with no small relish by the entertained bystanders."

Sir John then described his method of determining the solar constant by means of a tinned iron vessel 3⅝ ins. diameter, and 2·4 ins. high filled with inked water, upon which he allowed the nearly vertical rays of the sun to play through a 3·024 ins. diameter hole for ten minutes and noted the rise in temperature, of course allowing for cooling losses. The mean of six experiments, made between December 23rd, 1836, and January 9th, 1837, inclusive, gave a rise of 0·38° F. per minute, the quantity of water being 4,638 grains. Allowing for the obliquity of the sun's rays, the mean area of the normal cross-section of the beam of sunlight was 7·01 sq. ins. From these particulars we are able to calculate that Herschel's value of the solar radiation reaching the earth's surface was 1·38 calories sq. cm. min., while if we assume the coefficient of atmospheric transmission to have been 0·70, his value of the solar constant was 1·98, agreeing well with 1·93, the value now accepted as correct.

From these experiments he deduced that a cylindrical rod of ice, 45·3 miles in diameter, and of indefinite length, continually darted into the sun with the velocity of light (186,000 miles per second), would barely suffice to employ the whole radiant heat for its fusion, without at all reducing the temperature of the sun.

For comparison with Herschel's sand temperatures recorded above, the author gives the following similar readings which he obtained at Meadi, Egypt.

Date.	Time.	Reading of Thermometer under Loose Lamp-black and Sand.	Reading of Thermometer under Ordinary Sand.	Thermometer with Blacked Bulb lying on Sand.	Shade Temperature.	Humidity per Cent.	Wind. Velocity in Miles per Hour.	Wind. Direction.
1913.		°F.	°F.	°F.	°F.			
July 14th	4.30 p.m.	—	110	—	93	37	Fair breeze.	
,, 15th	2.30 ,,	—	120	—	90	37		
,, 18th	9.45 a.m.	—	120	—	92½	45	No wind.	
	11.30 ,,	—	130	—	92½			
	4.20 p.m.	—	123	—	97	34	Slight wind.	
,, 19th	12. 0 noon	—	125	—	94	33	Slight breeze.	
,, 24th	11.45 a.m.	107	127	—	89½	40	2·7	N.
,, 26th	11. 0 ,,	122	132	144	89½	33	2·9	N.W.
	12. 0 noon	127	138	145	91½			
	3. 0 p.m.	127	125	128	94			
	4. 0 ,,	120	115	123	94	32	2·7	
	5. 0 ,,	105	103	105	91			
August 2nd	11.10 a.m.	116	—	143	99	33	1·9	N.E.
	12. 0 noon	122	—	144	102			
	2.45 p.m.	126	—	140½	—			
	4.22 ,,	115	—	125	—			

Almost contemporaneous with the work of Herschel was that of Mons. C. S. M. Pouillet, a record of which, on the determination of the solar constant, appears in *Comptes Rendus*, Vol. VII., 1838, pp. 24–65. His value of the solar constant was 1·763 calories sq. cm. min.

Carl Güntner was at work experimenting with reflectors in Laibach in 1854, and in 1873 he exhibited one at the Vienna Exposition. Güntner wrote in the *Scientific American Supplement* of May 26th, 1906, pp. 25, 409–412:

"This reflector possessed, however, the disadvantages common to all sheet-metal reflectors, that to maintain the surface in proper condition when exposed to all sorts of weather requires careful and costly attention.

"Being convinced, however, that the exploitation of solar heat will come more and more into vogue, even in spite of the disadvantageous periodicity of this source of warmth, I have taken the trouble to put aside the evil mentioned above, and overcome it by an entirely new method of reflector construction . . . This plane reflector consists of a large number of long, narrow mirrors placed at suitable distances from one another, and which, when upon level ground, lie parallel with each other horizontally, extending either from north and south or from east to west.

"Each one of these mirrors revolves about a horizontal axis, and by means of a simple parallelogram motion may be made to follow the sun in such a manner that all the sun's rays falling upon the plane mirrors may be reflected on the surface of a tube or boiler, the long axis of which lies also in the plane of the mirror axis . . . by a simple movement of a hand lever, all the mirrors may be simultaneously turned through an arc of 180°, which means that all the mirrors may thus be made to look towards the ground, and be in this way protected from the destructive action of sudden falls of hail."

He claimed that the reflector could be made at a cost of 8*s.* 6*d.* per square yard of reflecting surface, and that it required "but 200 square feet of surface to generate steam sufficient for one horse-power." He proposed to construct the reflectors of thin corrugated steel plates, faced with lead and then coated with tin.

"Hence it is necessary to discover the value of *e* (the amount of useful heat dispensed per unit of surface per minute) which affords the unit of heat that can be made available for effective service from a square foot of catching surface per minute.

"Being deprived of the experience of any former experimenter in this direction, I myself made appropriate trials with reflectors . . . The two opposite sides, each 3 ft. long, of a wood right-angular frame, having a width of 1 ft. and a length of 3 ft., were hollowed out to correspond with a previously designed parabolic template, and upon the parabolic curve thus established two sheets of white tin were nailed. Four supports, which were fastened to the sides of the frame, carried a 3½-in. tube erected in such a manner that its axis coincided with the burning axis of the reflector . . The catching surface presented a superficial area equal to 3 square feet . . . The boiler was not lagged with glass or anything."

He then gives a table of four tests of one hour each, varying from 9 a.m. to 4 p.m., and goes on to say: "From these experiments it has been deduced that the amount of heat given off per square foot per minute is about $=1\cdot3$ (major) calories ($=1\cdot4$ minor calories sq. cm. min.).

"For our zone [probably Laibach, Austria], then, the mean value of *e* may be set down as $1\cdot3$."

The work of August Mouchot in connection with the utilisation of solar energy was certainly of great importance. It is recorded in his book, entitled "La Chaleur solaire et les Applications industrielles," second edition, 1879; but, as with other workers in this field, he gives extremely meagre information as to results of experiments.

Mouchot started his solar work in 1860, and took out his first patent, No. 48,622, on March 4th, 1861. In the first edition of his above-named work (page 231) he stated that theoretically, on an average, 86 square feet of reflecting surface are required for one horse-power. Then, to allow for losses, he doubled the area, thus making it 172 square feet. It is to be noted that he referred to reflecting surface and not the area of radiation collected, which would almost certainly be a smaller quantity.

On page 195 he described one of his boilers as having a capacity of three and a half pints. It consisted of two cylindrical concentric copper vessels with domed tops and the water space between them. The vertical height of the outer vessel was 16 ins. The boiler was covered by a bell-glass and placed at the focus of a reflector. The water boiled in one hour from an initial temperature of 50° F.

In August, 1866, Emperor Napoleon III. of France saw Mouchot's first solar engine at work in Paris, and in 1872 Mouchot (with the monetary assistance of the French Government) constructed another sun-boiler. This was described by Mons. L. Simonin in the *Revue Des Deux Mondes* of May 1st, 1876, as follows:—

"The traveller who visits the library of Tours, sees in the courtyard in front a strange-looking apparatus. Imagine an immense truncated cone, a mammoth lamp-shade, with its concavity directed skyward. This apparatus

is of copper, coated on the inside with very thin silver-leaf. On the small base of the truncated cone rests a copper cylinder, blackened on the outside, its vertical axis being identical with that of the cone. This cylinder, surrounded as it were by a great collar, terminates above in a hemispherical cap, so that it looks like an enormous thimble, and is covered with a bell-glass of the same shape.

"This curious apparatus is nothing else but a solar receiver—or, in other words, a boiler —in which water is made to boil by the heat-rays of the sun. This steam-generator is designed to raise water to the boiling-point and beyond by means of the solar rays, which are thrown upon the cylinder by the silvered inner surface of the conical reflector. The boiler receives water up to two-thirds of its capacity through a feed-pipe. A glass tube and a steam gauge communicating with the inside of the generator, and attached to the outside of the reflector, indicate both the level of the water and the pressure of the steam. Finally, there is a safety valve to let off the steam when the pressure is greater than desired. Thus the engine offers all desirable safety, and may be provided with all the accessories of a steam-boiler.

"The reflector, which is the main portion of the generator, has a diameter of 2·60 metres at its large, and 1 metre at its small base, and is 80 centimetres in height, giving 4 square metres of reflecting surface, or of insolation. The interior walls are lined with burnished silver, because that metal is the best reflector of the heat-rays; still, brass with a light coating of silver would also serve the purpose. The inclination of the walls of the apparatus to its axis measures 45°. Even the ancients were aware that this is the best form for this kind of metallic mirrors with linear focus, inasmuch as the incident rays parallel to the axis are reflected perpendicularly to the same, and thus give a focus of maximum intensity.

"The boiler is of copper, which of all the common metals is the best conductor of heat; it is blackened on the outside, because black possesses the property of absorbing all the heat-rays, just as white reflects them; and it is enclosed in a glass envelope, glass being the most diathermanous of all bodies, that is to say, the most permeable by the rays of luminous heat. Glass further possesses the property of resisting the exit of these same rays after they have been transformed into dark rays on the blackened surface of the boiler.

"The boiler proper of the Tours solar engine consists of two concentric bells of copper, the larger one, which alone is visible, having the same height as the mirror, *i.e.*, 80 centimetres, and the smaller or inner one 50 centimetres; their respective diameters are 28 and 22 centimetres. The thickness of the metal is only 3 millimetres. The feed-water lies between the two envelopes, forming an annular envelope 3 centimetres in thickness. Thus the volume of liquid is 20 litres, and the steam-chamber has a capacity of 10 litres. The inner envelope is empty. Into it pass the steam-pipe and the feed-pipe of the boiler. To the steam-pipe are attached the gauge and the safety-valve. The bell-glass covering the boiler is 85 centimetres high, 40 centimetres in diameter, and 5 millimetres in thickness. There is everywhere a space of 5 centimetres between its walls and those of the boiler, and this space is filled with a layer of very hot air."

Mechanism was provided whereby the reflector was adjusted by hand to follow the movement of the sun.

"On May 8th, 1875, a fine day, 20 litres of water, at 20° C., introduced into the boiler at 8.30 a.m., produced steam in forty minutes at two atmospheres (30 lb.) of pressure to the square inch, *i.e.*, a temperature of 121°, or 21° above boiling water. The steam was then raised rapidly to a pressure of five atmospheres (75 lb. to the square inch), and if this limit was not exceeded it was because the sides of the boiler were only 3 millimetres thick, and the total effort supported by these sides was then 40,000 kilogrammes. It would have been dangerous to have proceeded further, as the whole apparatus might have been blown to pieces.

"Towards the middle of the same day, with 15 litres of water in the boiler, the steam at 100°—that is to say, at a pressure of one atmosphere—rose in less than a quarter of an hour to a pressure of five atmospheres, equal to a temperature of 153°. Finally, on July 22nd, towards 1 p.m., an exceptionally hot day, the apparatus vaporised 5 litres of water per hour, which is equal to a consumption of 140 litres of steam per minute, and ½ h.p. For these experiments the inventor used an engine which made eighty strokes per minute under a continued pressure of one atmosphere. Later on it was changed for a rotative engine, that is to say, an engine with a revolving cylinder, which worked admirably, putting in motion a pump to raise water, until the pump, which was too weak, was broken."

In 1878 Mouchot used a boiler made of many tubes placed side by side, and having a capacity of 100 litres (70 for water and 30 for steam).

Mouchot seems to have been the only inventor of a solar plant, with the exception of Shuman, who has had his apparatus tested by independent engineers. The following refers to Mouchot's plant. In *Comptes Rendus*, Vol. XCIV. 1882, pp. 943–5, Mons. A. Crova reports that: "The Minister of Public Works appointed two Commissions, one at Constantine and the other at Montpellier, to make experiments with two identical mirrors of 5·22 square metres in section normal to the sun's rays, and to evaluate their practical utility.

"The Commission of Montpellier was composed of MM. Duponchel, Engineer-in-Chief of Ponts et Chaussées, as President; Colonel Fulcrand, R.E.; Guibal, and myself.

"The experiments (at Montpellier) lasted from January 1st to December 31st, 1881, and were made from hour to hour every day during which the sun was bright and the observations possible.

"The solar rays concentrated at the focal line of the mirror were received on a black boiler placed at the axis, and which was enclosed by a glass shade.

"The number of major calories utilised, divided by those incident, received in one hour upon 1 square metre of surface normal to the rays, gives the efficiency of the apparatus.

"Here are the principal results obtained during 176 days which gave 930 observations, during which 2,725 litres of water were distilled.

"MOYENNE GÉNÉRALE DES VALEURS MESURÉES PENDANT L'ANNÉE 1881, ET RAPPORTÉES À 1MQ ET À 1.

	Cal.	Max. Cal.	
Chaleur reçue directement	616·1	945·0	25 Avril.
Chaleur utilisée par l'appareil	258·8	547·5	15 Juin.
Moyenne des rendements	0·491	0·854	14 Juin."

The author has purposely not translated the last nine lines for fear of making a mistake. He is unable to interpret the results, but as they represent an important and independent investigation lasting a year, they are given in the hope that some of his audience may be able to throw some light on the matter.

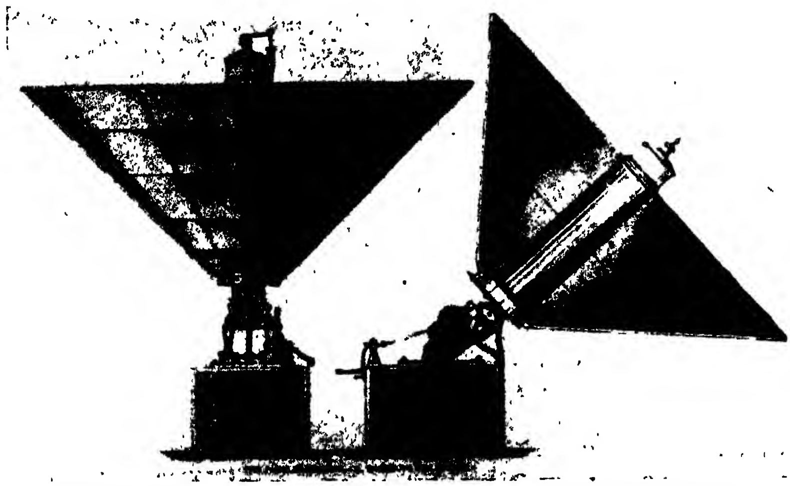

FIG. 2.—MOUCHOT'S MUTIPLE TUBE SUN-HEAT ABSORBER OF 1878.

Next came that versatile engineer and successful inventor, John Ericsson, a Swede by birth and an American by adoption. He made an immense number of experiments, extending over twenty years, with costly apparatus, to determine the solar constant, and later on made apparatus for the practical utilisation of solar radiation. All these experiments were made at his own expense, and he tells us they cost him £20,000, and having done all this work the conclusion he arrived at was: "The fact is, however, that although the heat is obtained for nothing, so extensive, costly, and complex is the concentration apparatus, that solar steam is many times more costly than steam produced by burning coal." (Letter dated September 21st, 1878, to R. B. Forbes.)

We have already referred to his remarkably accurate determination of the solar constant; but he was not so happy in deducing the

temperature of the sun, which he made to be 723,000° C., the present accepted result being only 6,000° C.

He tried hot-air engines as well as steam engines for utilising solar energy, and claimed that the steam engine which he constructed in New York for this purpose in 1870 was the first one driven by the direct agency of solar radiation. The diameter of its cylinder was 4½ ins. He afterwards modified his solar hot-air engine so that it might be used as a small pumping engine using gas as its heat supply. "The profits upon this chip from his workshop are already estimated at several times the amount of the £20,000 expended by Ericsson upon the solar investigations leading up to this invention" (Vol. II. p. 275 of his "Life," by W. C. Church). Mouchot claimed, apparently correctly, that his engine was the first, and Ericsson admits that, "Some time previous to 1870, Mouchot made a small model engine, a mere toy, actuated by steam generated on the plan of accumulation by glass bells . . ."

Ericsson gives full details of all his apparatus for determining the solar constant in the record of his life's work, entitled, "Contributions to the Centennial Exhibition," New York, 1876; but unfortunately he did not describe in detail therein the solar boilers, explaining that, "Experienced professional men will appreciate the motive, viz., that of preventing enterprising persons from procuring patents for modifications." He does, however, give us the following amount of information: "On grounds already fully explained, minute plans of my new system of rendering sun-power available for mechanical purposes will not be presented in this work. The occasion, however, demands that I should present an outline of the concentration apparatus before referred to. It consists of a series of polished parabolic troughs, in combination with a system of metallic tubes charged with water under pressure, exposed to the influence of converging solar rays, the augmented molecular action produced by the concentration being transferred to a central receiver, from which the accumulated energy is communicated to a single motor.

"Thus the mechanical power developed by concentrated solar heat is imparted to the solar steam engine without the intervention of a multitude of boilers, glass bells, gauges, feeders, etc. Moreover, the concentration apparatus, unlike the instrument of Mouchot, requires no parallactic motion, nor does its management call for any knowledge of the sun's declination from day to day. Its position is regulated by simply turning a handle, until a certain index coincides with a certain bright line produced by the reflection of the sun's rays."

His boilers seem to have been exceedingly efficient, for he claims that "the mechanism which I have adopted for concentrating the sun's radiant heat abstracts, on an average, during nine hours a day, for all latitudes between the equator and 45°, fully 3·5 units of heat per minute for each square foot of area presented perpendicularly to the sun's rays." 3·5 B.T.U. sq. ft. min. = 0·95 calories sq. cm. min. The mean transmission of solar radiation by the atmosphere over a zenith distance from 45° E. to 45° W. is 67·5 per cent. when the sky is clear. Thus $0·675 \times 1·93 = 1·31$ calories sq. cm. min. are available at the earth's surface. Hence the efficiency of Ericsson's boiler was $\frac{0·95}{1·31} \times 100 = 72·5$ per cent., which is remarkably high.

In 1872 Ericsson built his hot-air solar engine, which had a reflector the shape of which was approximately a portion of a sphere, and which concentrated the solar radiation on to one end of the cylinder. The power of both these engines was evidently very small. On July 9th, 1875, Ericsson wrote that he had up to that time constructed and started seven sun motors.

Ericsson wrote in *Nature* of January 3rd, 1884, an illustrated article describing another of his sun motors which he erected in New York in 1883, in spite of his opinion as to the cost of solar steam (previously quoted) expressed in 1878. His description was as follows: "The leading feature of the sun motor is that of concentrating the radiant heat by means of a rectangular trough having a curved bottom lined on the inside with polished plates so arranged that they reflect the sun's rays towards a cylindrical heater placed longitudinally above the trough. This heater, it is scarcely necessary to state, contains the acting medium, steam or air, employed to transfer the solar energy to the motor; the transfer being effected by means of cylinders provided with pistons and valves resembling those of motive engines of the ordinary type. Practical engineers, as well as scientists, have demonstrated that solar energy cannot be rendered available for producing motive power, in consequence of the feebleness of solar radiation. The great cost of large reflectors and the difficulty of producing accurate curvature on a large scale, besides the great amount of labour called for in preventing the

polished surface from becoming tarnished, are objections which have been supposed to render direct solar energy practically useless for producing mechanical power.

"The device under consideration overcomes the stated objections by very simple means, as will be seen by the following description: The bottom of the rectangular trough consists of straight wooden staves, supported by iron ribs of parabolic curvature secured to the sides of the trough. On these staves the reflecting plates, consisting of flat window-glass silvered on in diameter, 11 ft. long, exposing 130 × 9·8 = 1,274 superficial inches to the action of the reflected solar rays. The reflecting plates, each 3 ins. wide and 26 ins. long, intercept a sunbeam of 130 × 180 = 23,400 square inches section. The trough is supported by a central pivot, round which it revolves. The change of inclination is effected by means of a horizontal axle—concealed by the trough—the entire mass being so accurately balanced that a pull of 5 lb. applied at the extremity enables a person to change the inclination or cause the whole to

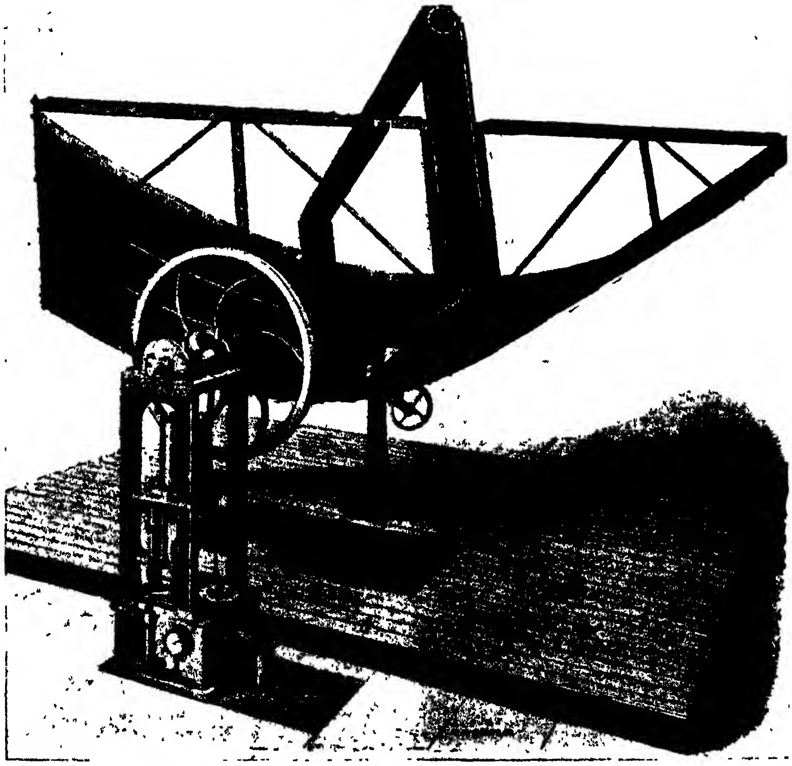

Fig. 3.—Ericsson's Sun-power Plant of 1883.

the underside, are fastened. It will be readily understood that the method thus adopted for concentrating the radiant heat does not call for a structure of great accuracy, provided the wooden staves are secured to the iron ribs in such a position that the silvered plates attached to the same reflect the solar rays towards the heater.

"Referring to the illustration, it will be seen that the trough, 11 ft. long and 16 ft. broad, including a parallel opening in the bottom, 12 ins. wide, is sustained by a light truss attached to each end, the heater being supported by vertical plates secured to the truss. The heater is 6¼ ins. revolve. A single revolution of the motive engine develops more power than needed to turn the trough, and regulates its inclination so as to face the sun during a day's operation.

"The motor shown by the illustration is a steam engine, the working cylinder being 6 ins. in diameter, with 8 ins. stroke. The piston-rod, passing through the bottom of the cylinder, operates a force-pump of 5 ins. diameter. By means of an ordinary cross-head secured to the piston-rod below the steam cylinder, and by ordinary connecting-rods, motion is imparted to a crank-shaft and fly wheel, applied at the top of the engine frame; the object of this arrangement

being that of showing the capability of the engine to work either pumps or mills. It should be noticed that the flexible steam-pipe employed to convey the steam to the engine, as well as to the steam-chamber attached to the upper end of the heater, have been excluded in the illustration. The average speed of the engine during the trials last summer was 120 turns per minute, the absolute pressure on the working piston being 35 lb. per square inch. The steam was worked expansively in the ratio of 1 to 3, with a nearly perfect vacuum kept up in the condenser enclosed in the pedestal which supports the engine frame.

"In view of the foregoing, experts need not be told that the sun motor can be carried out on a sufficient scale to benefit very materially the sun-burnt regions of our planet."

From the particulars given it is easily calculated that the "concentration" of this absorber was 9.

The Rev. C. H. Pope has produced a useful little book entitled "Solar Heat," the second edition of which was published in 1906. In it he tells us he started his experiments (which do not appear to have included the conversion of solar radiation into mechanical energy) in 1875. He used a modification of Mouchot's truncated cone reflector formed of many plane mirrors—the plan adopted about the same time by Adams. Pope has fallen into the same error *re* the connection between temperature and concentration of radiation as did Adams, for he says (p. 17): "That the degree and amount of heat at the focus will be proportionate to the area of the opening of the lens or mirror, and that thus the only limit to the temperature which may be reached is the size to which such lenses and mirrors may be constructed and revolved," and (p. 93): "These rays may, therefore, be gathered together and made to unite, as if they became one denser, stronger, hotter ray, so that the temperature of the condensed rays will be raised in proportion to the number of rays blended, and we can thus cause the heat to increase to any degree our apparatus can be enlarged."

W. Adams, Deputy Registrar, High Court, Bombay, seems to be the sole Englishman who has worked on the practical side of the problem of the utilisation of solar energy. His work was done in India, and is recorded in his interesting book "Solar Heat" (Bombay, 1878). He started on the work in 1876, and his experiments led him to conclude, as did Buffon, that silvered glass mirrors were superior to polished metal ones. This is no doubt true for ordinary use, though for laboratory experiments the polished metal ones give better results, as there is then no absorption by the glass.

In two particulars Adams was much at fault: (1) in believing that the solar rays which reach the earth are not practically parallel, and this in spite of the opposite opinions of the many physicists whom he quotes, and (2) in believing that the temperature attained at the focus of a lens or mirror is directly proportional to the concentration of the rays. As a consequence, he stated that if a lens 85 ft. 4 ins. in diameter concentrated the radiation on to a circle ½ in. in diameter the temperature would be 73,400,320° F. This is equal to 40,780,000° C., while the temperature of the sun itself is only 6,000° C., and no amount of such concentration could produce a temperature in excess of this. This error on the part of Adams and Pope seems to be due to a confusion of "temperature" with "quantity of heat."

His experiments were all made with plane or flat glass mirrors, the use of which he strongly advocated in preference to curved metal ones which Mouchot used. Sometimes he used groups of eighteen mirrors each 17 × 10½ ins., and sometimes of thirty-two, each 9 × 6 ins. The latter he arranged in a concave wooden frame in four tiers of eight in each tier. Such a group of thirty-two formed one unit, of which he had sixteen, all focused on to one boiler. When placed together, the sixteen units formed a portion of the surface of a hollow sphere 40 ft. in diameter. One of his boilers was of copper $\frac{1}{16}$ in. thick, 16 ins. diameter, 2 ft. 7 ins. high, and held 9 gallons of water which boiled in 30 mins. and evaporated 3¾ gallons in an hour.

His next boiler was also of copper ¼ in. thick, and of the same design and external dimensions as Mouchot's, but with a water space between the inner and outer shells of 3 ins., instead of 3 cm., and containing 12 gallons of water as compared with Mouchot's 4½ gallons. The 12 gallons of water were boiled and the pressure raised to 10 lb. sq. in. in the half hour from 7.30 a.m. to 8 a.m., and by 8.30 a.m. the pressure was 70 lb. sq. in. when the safety valve opened, whereupon he goes on to say: "A gentleman present kept the valve down by placing his foot on it, till the steam, escaping from several leaks in the joints of the fittings, made the position untenable. The weight on the safety valve was then supplemented by a brick suspended from the lever by a piece of string,

when suddenly the packing and red lead at the top of the dome under the socket of the steam-pipe (which had been fixed by my butler, who professed to have formerly been a fitter) gave way, and, with a terrific noise, the whole volume of steam rushed out of the opening. On turning off the solar rays and examining the boiler it was found to be dry. All the water had either been evaporated or blown out.

"When this boiler had been properly fitted up by professional fitters, a steam pump was hired, said to be of 2½ h.p., and it was connected with the steam-pipe. At 7.30 a.m. fire was opened on the boiler from the whole battery of sixteen mirrors, at a range of 20 ft., the boiler containing 12 gallons. At 7.45, *i.e.*, a quarter of an hour, there was a pressure of about 2 lb., and at 8.30 a.m. 55 lb. The steam was then turned into the cylinder of the pump, and the pump was kept working at a uniform pressure of about 30 lb. to the square inch.

"This pump, the first steam engine ever worked in India by solar heat, was kept going daily, for a fortnight, in the compound of my bungalow at Middle Colaba, in Bombay, and the public was invited, by a notification in the daily papers, to witness the experiments."

Adams also made a solar cooker, the reflector of which was formed of eight sheets of plane glass arranged so as to form a hollow truncated octagonal pyramid, 2 ft. 4 ins. in diameter at the larger end. The food was placed in a cylindrical copper vessel, at the axis, covered with an octagonal glass shade. With this he and others cooked many meals, both stews and roasts, and he records that both he and Mouchot found (p. 98) that animal fat "when exposed to the direct or reflected rays of the sun was converted into butyric acid, a substance having such an offensive odour and taste as to render the roast unpalatable. Mouchot then discovered that a sheet of red, pink, or yellow transparent glass, interposed between the roast and the reflector had the effect of preventing this fermentation, as those colours have the curious property of absorbing, neutralising, or eliminating the rays by which it is caused."

Adams also states (p. 36) that, "When the sacred fire that burned in the Temple of Vesta* became extinct, the ancient Romans used to rekindle it by placing a piece of dry wood in the linear focus of the conical reflector . . . To bring fire from heaven, by supernatural aid and a metal reflector was, no doubt, one of the most ancient miracles of priestcraft."

* Vesta, the Goddess of the Hearth.

He suggested many uses for solar heat, among others (p. 96), "for the cremation of deceased Hindus and others."

Taking into account the facts that he did not expend much money on his experiments, and that he did the whole of his solar work in eighteen months, it will be admitted his was a most creditable piece of work, especially as he was neither an engineer nor a physicist. To make this amply clear, he says: "I have neither the capital, the time, nor the practical knowledge required to conduct any business in which steam machinery is used. I know now that the 'governors' of a steam engine are the two iron globes which revolve about it, and not, as I had supposed, the two men who lubricate the machine and feed the boiler with coals. That is

FIG. 4.—ADAMS'S SOLAR COOKER, 1876.

nearly the extent of my knowledge of steam machinery."

In concluding this brief account of Adams's work, you will be pleased to learn that he was awarded the gold medal of the Sassoon Institute of Bombay for his essay on "The Utilisation of Solar Heat," which he submitted in March, 1878.

In *Comptes Rendus*, Vol. XCI. 1880, pp. 388–9, Mons. Abel Pifre claims an efficiency of 80 per cent. for his apparatus when, he says, he obtained a rate of absorption of 1·21 calories sq. cm. min. If such a rate were obtained, we now know it would mean an efficiency of 89·7 per cent., which is improbable. Pifre used a parabolic reflector (instead of a truncated cone), and reduced the surface of the boiler, thus increasing the concentration. The capacity of his boiler was 11 gallons, and he collected 100 sq. ft. of solar radiation, so the diameter of his reflector was about 11 ft. 4 ins. He used a rotary pump, and raised 99 litres of water 3 metres in

14 minutes, which is equivalent to 0·065 h.p. He ran a printing press with his sun-power plant, and claimed that if he had collected 216 sq. ft. of radiation he could have produced 1 h.p., which is quite likely.

Next in order we have Langley's work, which consisted of many experiments to determine the value of the solar constant, the value of which he gave as 3·0 calories sq. cm. min.

Langley experimented with de Saussure's "hot box," and was the leader of the expedition to Mount Whitney, where some of his best work was done. He gave a preliminary account of this trip in *Nature* of August 3rd, 1882, pp. 314–17, and a full record of it under the title "Researches on Solar Heat" in the U.S.A. War Dept., Papers of the Signal Service, XV., 1884. He also referred to it in "The New Astronomy" (1900).

In *Nature* (p. 315) he said: "As we still slowly ascended, and the surface temperature of the soil fell to the freezing-point, the solar radiation became intenser, and many of the party presented an appearance as of severe burns from an actual fire, while near the summit the temperature in a copper vessel, over which were laid two sheets of plain window glass, rose above the boiling-point, and it was certain that we could boil water by the direct solar rays in such a vessel among snowfields."

In Vol. LXXIII. of the *Proceedings*, Inst. C.E., 1883, p. 284, is described a plant designed by J. Harding, M.Inst.C.E., for distilling water by solar radiation.

This plant was erected at Salinas, Chile, 4,300 ft. above sea-level, and had 51,200 sq. ft. of glass arranged in sections 4 ft. wide, and in the form of a very flat Λ, forming the roof of a shallow water trough. The sun evaporated the water, and the resulting vapour condensed on the glass, for the temperature in the box was far higher than that of the atmosphere, and hence of the glass. The pure water trickled down the sloping glass and dripped from its lower edge into a small channel on the top of each side of the box. These channels delivered into larger ones, and thus the distilled water was collected. The plant yielded 5,000 gallons of pure water per day in summer, *i.e.*, 1 lb. of water per square foot of glass. Allowing for interest on capital, cost of repairs, etc., the cost of the pure water is said to have been less than ¼*d.* per gallon. The chief item of expense was the breakage of glass by whirlwinds. Distillation started at 10 a.m. and continued to 10 p.m. The maximum temperature of the water in the troughs was 150° F. The total cost of the plant, including pumps, windmills and tanks, was $50,000, or 1*s.* 6*d.* per square foot of glass.

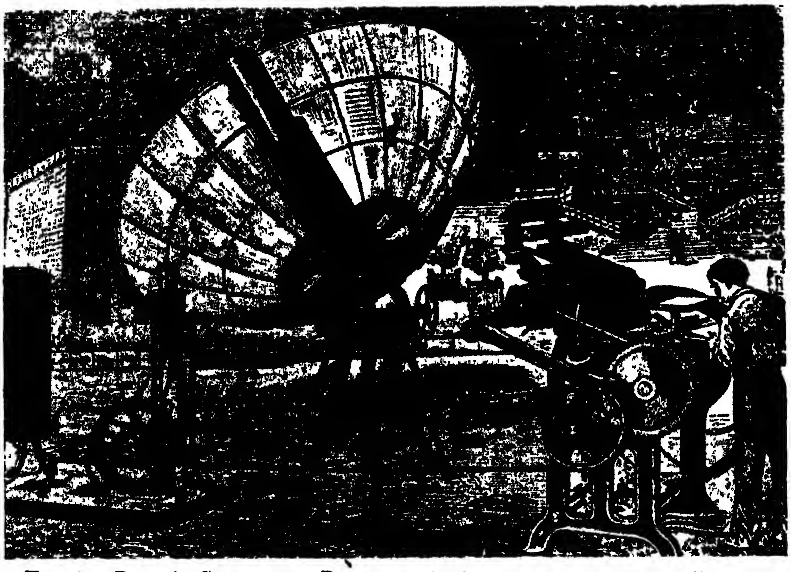

Fig. 5.—Pifre's Sun-power Plant of 1878 driving a Printing Press.

It is not clear when the solar energy problem first engaged the attention of C. L. A. Tellier, a French refrigerating engineer; but in 1889 he published his book, "Élévation des Eaux par la Chaleur Atmosphérique," in which he gave many drawings and details, and a very full description of his plant. He may have been the first to use the lamellar boiler, but the

U.S. Patent No. 230,323, of July 20th, 1880, of MM. Molera and Cebrian, shows that they proposed this form of boiler. The dimensions of each section of Tellier's boiler were 3·50 m. × 1·12 m. They were made of thin plates of iron, so riveted together as to give them a quilted formation. They were filled with ammonium hydrate, which, he says, when heated by the sun produced gaseous ammonia at a pressure of "several atmospheres." The ammonia gas was used in a small vertical engine, and was then liquified in a condenser and used again. The boilers were fixed in a sloping position so as to "face the sun," and two somewhat fanciful illustrations show them used as roofs of verandahs. The boilers were insulated on their lower or shade sides to prevent loss of heat, and were placed in shallow boxes with only one layer of glass to form the cover. He experimented with different coloured glass, and found, as might be expected, that colourless glass gave the best results. He also gave complete details of his invention as applied to the manufacture of ice. With so much detail it is disappointing that the author could not find the results of a single experiment with the plant. In fact, he is not sure whether Tellier ever constructed one.

In his work "La Conquête Pacifique de l'Afrique Occidentale" (1890), Tellier discussed social and economical questions, and showed how improvements might be made by rendering the deserts of Africa productive by means of his sun-power plants.

A. G. Eneas, in the United States, used the popular truncated cone-shaped reflector, collecting about 700 sq. ft. of solar radiation. The weight of the reflector was 8,300 lb.

The boiler was formed of two concentric steel tubes, the two together being encased in two glass tubes with an air space between them, and another air space between the inner glass one and the outer steel tube. The water circulated up between the inner and outer steel tubes and down the inner tube. The boiler was placed at the axis of the cone. Its length was 13 ft. 6 ins., its water capacity 834 lb. (13·4 cubic ft.), and steam space 8 cubic ft. Hence the diameter of the outer tube appears to have been 1 ft. 2 ins., and the concentration of radiation 13·4, *i.e.*, 13·4 sq. ft. of sunshine were concentrated on each square foot of the external surface of the boiler.

C. G. Abbot ("The Sun," p. 369) states that Eneas gave him the following particulars :—

"February 14th, 1901.—Pasadena, California, 11.30 a.m.—0.30 p.m. 642 sq. ft. sunshine. Temperature of air, 61° F. Steam pressure, 145–151 lbs. sq. in. Steam condensed, 123 lb.

"October 3rd, 1903.—Mesa, Arizona, 'About midday.' 700 sq. ft. sunshine. Temperature of air, 74° F. Average steam pressure, 141 lb. per sq. in. Steam condensed, 133 lb.

"October 9th, 1904. — Willcox, Arizona, 11.0—12.0. 700 sq. ft. sunshine. Steam pressure, 148–156 lb. sq. in. Steam condensed, 144·5 lb."

The temperature of the feed-water is not given, but assuming it to be the same as the temperature of the air, we can deduce the rate of absorption per square foot of radiation, and the thermal efficiency of the absorber. This being done we obtain the following table :—

Place and Date.	Period.	Weight of Steam produced in lb.	Mean pressure of steam in lb. sq. in. abs.	Rate of absorption per square foot of radiation collected. B.T.U. per hour.	Thermal Efficiency of the Absorber. Per cent.*
Pasadena, Feb. 14th, 1901.	11.30 a.m. to 0.30 p.m.	123	163	223	74·6
Oct. 3rd, 1903.	"About midday"	133	156	219	73·3
Willcox, Oct. 9th, 1904.	11.0 a.m. to 12.0 noon	144·5	167	238	79·6

* For a maximum transmission of radiation through the atmosphere of 70 per cent.

Eneas refers to his "nine different types of large reflectors," and found that he obtained better results when he concentrated the reflected rays "on two parts of the boiler instead of its entire length, as in the Pasadena machine." The unexposed portions of the boiler then appear to have been lagged.

Eneas said, "I find 3·71 B.T.U. per sq. ft. per min. as the greatest amount of heat obtainable during the trial runs." This gives a maximum efficiency of 74·5 per cent., which agrees

with the result given for his Pasadena plant in the foregoing table.

Eneas also stated that, "the interposition of a single thin glass plate in a beam of sunlight diminishes the intensity about 15 per cent. This decrease is owing principally to reflection." On p. 466 of Preston's "Treatise on Heat," it is stated that, "Mirror glass 2·6 mm. thick transmitted 39 per cent. of the radiation that fell on it from a Locatelli lamp, while rock-salt transmitted 92 per cent." The diathermancy of each substance varies with the nature of the source of heat, so the result just given is not comparable with that given by Eneas.

Abbot found the following percentages of heat were transmitted through sheets of glass, each from 1·5 to 2 mm. thick. In one set of experiments the glass was normal to the rays, and the other at 45°.

Number of Sheets of Glass.	Percentage transmission.	
	Rays normal to glass.	Rays at 45° to glass.
1	86·5	85·0
2	74·5	71·8
3	63·5	60·0
4	53·3	49·0

FIG. 6.—THE PASADENA SUN-HEAT ABSORBER OF 1901.

The sun-power plant known as the Pasadena* one was described and illustrated in the August, 1901, issue of *Cassier's Magazine* by Professor R. H. Thurston, LL.D., D.E., and on p. 103 of *The Railway and Engineering Review* of February 23rd, 1901. It is stated to have

* There appear to have been several plants erected at Pasadena by different experimenters. Probably Eneas designed the plant above described.

been designed by, and erected at the expense of, "a party of Boston inventors whose names have not been made public." It consisted of a truncated cone reflector, 33 ft. 6 ins. in diameter at the larger end and 15 ft. diameter at the smaller, with a boiler 13 ft. 6 ins. long, having a capacity of 100 gallons (U.S.A.) plus 8 cubic ft. of steam space.

The article in *The Railway and Engineering Review* states: "According to newspaper accounts, the all day average work performed by the engine is 1,400 gallons (U.S.A.) of water lifted 12 ft. per minute, which is at the rate of 4 h.p." It is more nearly 4¼ h.p., thus this plant required 150 sq. ft. of radiation per horse-power, and the concentration appears to have been 13·4.

The Pasadena plant is said to have cost £1,000, and Willsie, writing of it in 1909, says it was "the largest and strongest of the mirror type of solar motor ever built."

H. E. Willsie and John Boyle, Jun., started their work in America in 1902. The method they adopted was to let the solar radiation pass through glass and heat water, which in turn was used to vaporise some volatile fluid such as ammonium hydrate, ether, or sulphur dioxide, the vapour being used to drive an engine.

Willsie thinks he was the first to propose this two-fluid method for the utilisation of solar energy, and so far as the author knows his claim is correct. Their first sun-heat absorber was built at Olney, Illinois, U.S.A., and consisted of "a shallow wooden tank tightly covered with a double layer of window glass. The sides and bottom were insulated by enclosed air spaces filled with hay. The tank was lined with tar paper, well pitched to hold water to the depth of 3 ins. Although the weather was cold and raw, even for October with occasional clouds, the thermometer in the water showed temperatures higher than were needed to operate a sulphur dioxide engine.

"The next solar heater was built at Hardyville, Arizona. Sand was used for insulation. Three tests for the amount of heat gave these average results in December:—

Test No.	Heat units absorbed per sq. ft. per hour.
1	120
2	122
3	148

"An estimate showed that 50 per cent. of the heat reaching the glass was absorbed into the water.

"In 1903 some further heater tests were made, patent applications filed, and to carry on experiments on a more extensive scale the Willsie Sun Power Company was incorporated.

"In the spring of 1904 a complete sun-power plant was built at St. Louis. In this installation a 6 h.p. engine was operated by ammonia. The heater consisted of a shallow wooden basin coated with asphalt and divided by strips into troughs. It was covered by two layers of window-glass and insulated at the sides and bottom by double air spaces. Each trough of the heater formed a compartment. The troughs were inclined so that a thin layer of water flowed from one trough to the next. In this heater was collected and absorbed into the water from the sun's rays 211,500 heat units per hour at noon, or 377 heat units per hour per square foot of glass exposed to the sun. As, according to accepted solar observations, about 440* heat units per hour reached a square foot of glass, this heater was showing the surprising efficiency of 85 per cent., and collecting nearly twice as much solar heat per square foot per hour as did the apparatus of Ericsson. Of the lost heat I estimated that 40 heat units were reflected and absorbed by the glass and that 23 heat units were radiated. On cloudy days the water could be heated by burning fuel. A description of this plant appeared in a St. Louis paper and in a New York paper, but so far as I know it has not been mentioned in any technical publication.

"It was then decided to build a sun-power plant on the desert, and some land about a mile from the Needles, Cal., was purchased for a site."

This Needles plant used sulphur dioxide, and its results decided them to build a larger plant, which Willsie speaks of as their third sun-power plant, and describes as follows: "A 20 h.p. slide-valve engine was connected to an open-air water-drip condenser and to a fire-tube boiler 22 ins. × 19 ft. having fifty-two 1-in. tubes. The solar-heated liquid flowed through the tubes giving up its heat to the sulphur dioxide within the boiler. Boiler pressures of over 200 lb. were easily obtained. The engine operated a centrifugal pump, lifting water from a well 43 ft. deep (*sic*), and also a compressor, in addition to two circulating pumps."

Their fourth plant was a rebuilding of the third, and they tried the expedient of covering the heat-absorbing water with a layer of oil, but the results were not so good as when a heat-absorbing liquid (water, or oil, or a solution

* No, only 299. Note.—0·70 × 1·93 = 1·352 calories sq. cm. min. = 299 B.T.U. square foot hour.

of chloride of calcium) was rapidly circulated in a thin layer. The sun-heat absorber for this plant was in two sections, one covered with one layer of glass and one with two layers, and both on a slope, the liquid running from the first to the second, and its temperature in the two sections being 150° F. and 180° F. respectively. The liquid at 180° F. was distributed over a "heat exchanger" consisting of horizontal pipes about 3 ins. in diameter arranged in a vertical plane, something like an air condenser. The pipes contained sulphur dioxide, and the heat-absorbing liquid lost about 100° F. in its descent. The cooled liquid was returned to the two sections of the absorber to be reheated. The heat exchanger was enclosed in a glass-covered shed. Willsie says: "The engine used in this experiment was a vertical automatic cut-off, which at times, with a boiler pressure of 215 lb., probably developed 15 h.p. The two-heater sections exposed an area of about 1,000 sq. ft. to the sun, but as the heat was taken from storage and not directly from the heater, it is not fair to assume the above proportion of heater surface to horse-power developed.

"The condenser consisted of six stacks of horizontal pipes, twelve pipes to the stack. The cooling water, pumped from a well 43 ft. deep, had a temperature of 75° F. Only enough water was allowed to drip over the pipes to keep them wet, and so great was the evaporation in the dry desert breeze that the cooling water left the lower pipes at 64°. By using the cooling water over and over, the condenser gave very satisfactory results. A shade of arrowweed, a straight willow-like shrub abundant along the Colorado River, kept the sunshine from the condenser pipes and permitted a good air circulation."

Willsie estimated the cost of his sun-power plant, complete with engine, at £33 12*s*. per h.p.

With regard to Willsie's results, it is to be noted that 377 B.T.U. per hour means an efficiency of $\frac{377 \times 100}{60 \times 0{\cdot}70 \times 7{\cdot}12} = 126$ per cent.; for we now know that a maximum of only about 299 B.T.U. per square foot per hour penetrate the atmosphere. The author agrees with the 50 per cent. efficiency given a little earlier by Willsie.

Frank Shuman, of America, started on the problem in 1906, and in 1907 he had a plant running which developed about 3½ h.p.; 1200 sq. ft. of sunshine fell on to a fixed, horizontal water-box with a glass top. In the water there were rows of parallel horizontal black pipes containing ether, and exposing 900 sq. ft. of surface to the solar radiation. The water also became heated and conveyed heat to the under sides of the pipes. The ether boiled, and its "steam" drove a small vertical, simple, single-cylinder engine. The exhaust ether vapour passed into an air surface condenser, and the liquid ether from this was pumped back into the tubes of the "boiler" already described.

This plant, Shuman says, ran well even when snow was lying on the ground. This at first seems very remarkable, but though in the winter the number of solar rays falling on a given horizontal area is smaller than in summer, the permeability of the atmosphere is about 20 per cent. greater in winter than in summer, which counteracts the other effect: but of course the loss of heat by conduction from the boiler is greater in winter than in summer.

In 1910 Shuman constructed an experimental unit of an absorber measuring 6 ft. × 9 ft. This unit combined the lamellar boiler of Tellier and the hot box of de Saussure, for it consisted of a shallow black box with double glass top with 1 in. of air space between the two layers of glass, another air space of an inch between the lower glass and the boiler, which was 6 ft. long (up the slant), 2 ft. 6 ins. wide, and ¼ in. thick over all. The box was so sloped that at noon the rays of the sun were perpendicular to the glass. The box was not moved to follow the sun, but it was adjusted about every three weeks, so that the condition just named was complied with. The remarkable thing about the absorber was that there was no concentration of any kind of the sunshine by mirrors, lenses or other means, and yet the author on one occasion recorded a temperature of 250° F. in the box. The best run of an hour's duration produced steam at atmospheric pressure at the rate of 7½ lb. per 100 sq. ft. of sunshine falling on the box. The author's tests of a Shuman 100 h.p. low-pressure engine at Erith showed the steam consumption to be 22 lb. at atmospheric pressure per brake horse-power hour. Hence, with an absorber of the type just described, it would be necessary to collect solar radiation to the extent of 300 sq. ft. per brake horse-power, which is a much larger area than any named by other workers. The maximum thermal efficiency of this absorber was 24·1 per cent.

In 1911, with the aid of some English capitalists, Shuman constructed his third absorber at Tacony (a suburb of Philadelphia), which was almost identical with the one just described, except that it had two plane mirrors,

FIG. 7.—GENERAL VIEW FROM THE WEST OF THE SHUMAN ABSORBER, TACONY, 1911.

one at the upper edge of the hot box and one at the lower, so arranged that 6 sq. ft. of sunshine were concentrated on to 3 sq. ft. of hot box, *i.e.*, the concentration was 2 to 1. Its position was adjusted about every three weeks. This time the total quantity of solar radiation collected as many times as large as the largest collected by any previous worker, for the total area was 10,296 sq. ft. In the best run of one hour this plant produced 816 lb. of steam at atmospheric pressure. This is at the rate of 9 lb. per 100 sq. ft. of sunshine, and therefore equivalent to an allowance of 245 sq. ft. of sunshine per brake horse-power. The maximum thermal efficiency of this absorber was 29·5 per cent.

Towards the end of 1911 the Sun Power Company (Eastern Hemisphere), Limited, requested their consulting engineers (Messrs. A. S. E. Ackermann and C. T. Walrond) to select and invite some distinguished physicist to join them in a consultative capacity. Hence Professor C. V. Boys, F.R.S., became associated with the work, and he suggested a vital change in the design of the absorber, viz., that the boilers should be placed on edge in a channel-shaped reflector of parabolic cross-section, so that solar radiation was received on both their surfaces, instead of one being worse than idle, as it was when the boilers were placed "side on" to the sun. The design immediately received the hearty approval of the consulting engineers and

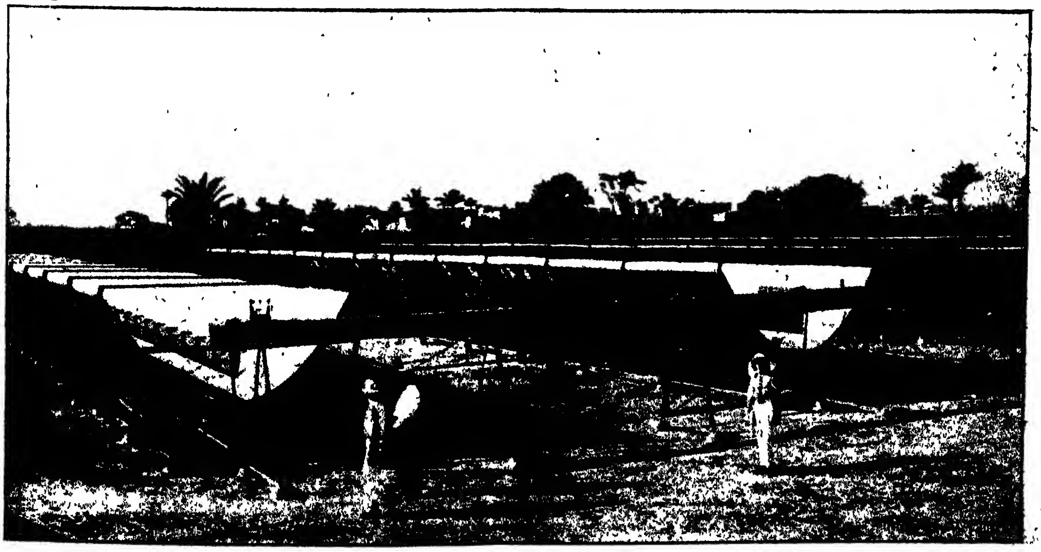

FIG. 8.—GENERAL VIEW FROM THE SOUTH OF THE SHUMAN-BOYS ABSORBER, MEADI, 1913.

Shuman, and at the time we all thought the arrangement was novel, but the author has since found and recorded herein that Ericsson used a very similar reflector and boiler.

An absorber of this design was constructed and erected at Meadi on the Nile, seven miles south of Cairo, in 1912, but the boiler was constructed of thin zinc and failed before the official tests could be made. This boiler was replaced by a cast-iron one in 1913, and the author (accompanied by his old pupil, G. W. Hilditch, A.M.Inst.C.E., as his chief assistant, now Lieut. Hilditch of the Divisional Engineers, Royal Naval Division) spent two most interesting months with the plant in July and August, 1913. He went out in time to tune up the Shuman engine (a 100 h.p. one) taken out from Tacony, and make all the necessary preparations for the trials, of which there were over thirty-five.

In addition to the alteration of the shape of the reflectors, another very important change was made. Their axes were placed north and south, and they were automatically heeled over from an eastern aspect in the morning to a western one in the evening so as to "follow the sun." Thus the same number of solar rays were caught all day long, and the small decrease in steam production in the morning and evening was almost entirely due to the greater thickness of atmosphere through which the rays had to pass. The total area of sunshine collected was 13,269 sq. ft.

The boilers were placed at the focus of the reflectors and were covered with a single layer of glass enclosing an air space around the boilers. Each channel-shaped reflector and its boiler was 205 ft. long, and there were five such sections placed side by side. The concentration was 4½ to 1. The maximum quantity of steam produced was 12 lb. per 100 sq. ft. of sunshine, equivalent to 183 sq. ft. per brake horse-power, and the maximum thermal efficiency was 40·1 per cent. The best hour's run gave 1,442 lb. of steam at atmospheric pressure, hence (allowing the 22 lb. of steam per brake horse-power hour) the maximum output for an hour was 55·5 b.h.p., a result about ten times as large as anything previously attained and = 63 b.h.p. per acre of land occupied by the plant. A pleasing result was that the output did not fall off much in the morning and evening. Thus on August 22nd, 1913, the average power for the five hours' run was no less than 59·4 b.h.p. per acre, while the maximum and minimum power on that day were 63 and 52·4 b.h.p. per acre respectively.

The work of MM. G. Millochau and Ch. Féry was started in 1906 to determine the solar constant and the temperature of the sun. Their work is recorded in *Comptes Rendus* for 1906

FIG. 9.—SHUMAN-BOYS ABSORBER, MEADI, 1913. ONE SECTION OF THE ABSORBER FROM THE NORTH.

and 1908, and in the *Revue Scientifique* of September 7th, 1907. They give the absolute temperature of the sun as 6,042° C., and the value of the solar constant as 2·38 calories sq. cm. min. This latter value was the result of experiments they made on the summit of Mont Blanc in 1908.

The article in the *Revue Scientifique* of September 7th, 1907, is by Millochau, and in it he gives the following list of experimenters and the results of their determination of the solar constant, after reading which some may consider the word *constant* a misnomer:—

Pouillet	1837	1·793
Forbes	1842	2·82
O'Hagen	1863	1·9
Voille	1875	2·28 to 2·37
Langley	1884	3·068
Savelief	1889	3·47
Pertner	1889	3·05 to 3·28
Angerström	1890	4·00
Hansky	1905	3·29

To these we may add:—

Herschel	1837	1·98
Ericsson	1876	1·93
Millochau and Féry	1907	2·38
Abbot	1913	1·93

In spite of this history of comparative failures, the author is of opinion that the problem of the utilisation of solar energy is well worthy of the attention of engineers, for even now it is very nearly a solved problem where there is plenty of sunshine and coal costs £3 10*s*. a ton. It is fortunate that where coal is dear sunshine is often plentiful, and it is to be remembered that coal will gradually get dearer while the cost of manufacture of sun-power plants should decrease. Sun-power plants are admirably suitable for pumping in connection with irrigation, for where there is most sunshine there is need for most irrigation, and the slight variation in the quantity of water pumped throughout the day does not matter. Also, when temporarily there is no sunshine (due to clouds), probably little or no irrigation is required.

In conclusion, the author would refer those who are interested in the subject to his paper (8vo, 86 pages, with 22 illustrations), bearing the same title as this one, presented to the Society of Engineers on April 6th, 1914. Therein he dealt fully with the whole of Shuman's work from 1910–13 inclusive, and gave details of the results of the sixty-two trials of the plant made by the author in England, the United States and Egypt.

APPENDIX I.

HEAT REJECTED.

In the case of the Shuman-Boys absorber, tested by the author at Meadi, Egypt, it seemed reasonable to suppose that when the boilers were naked—*i.e.*, when they were not covered with clear glass to prevent loss by heat by conduction—the quantity of solar heat not used would bear some relation to the difference between the temperature of the boiler and that of the atmosphere. On calculating the quantity of unused heat per hour in B.T.U. per square foot of boiler surface for the first ten trials, *i.e.*, all those in which the boilers were naked, we obtain the following results, and as the maximum variation is only from 5·5 below the mean to 5·1 above it, we may, perhaps, call the quantity a constant:—

Trial No.	Solar heat not used expressed in B.T.U. per hour per square foot of boiler surface per 1° F. difference in temperature between the boiler and the air.
1	8·20
2	8·85
3	9·12
4	8·99
5	8·73
6	8·85
	8·68
	8·56
	8·47
10	8·37
Mean	8·68

The quantity is not constant when the boilers are covered.

APPENDIX II.

THE THEORETICAL THERMAL EFFICIENCY OF A SOLAR HEAT ABSORBER.

The available solar heat per square foot of radiation is sa where s is the solar constant in B.T.U. per square foot per min. = 7·12, and a is the coefficient of atmospheric transmission which varies with the time of day. Under good conditions

the available solar heat (= 60 *sa* B.T.U. per hour) is as follows:—

Time of day. A.M.	Available heat in B.T.U. per normal square foot of solar radiation per hour.
7.0	225
8.0	260
9.0	276
10.0	288
11.0	295
noon	299
P.M.	
1.0	295
2.0	288
3.0	276
4.0	260
5.0	225

The loss of heat in the case of an absorber consisting of a reflector and naked boiler is made up of several factors, including r, the loss due to the inefficiency of the reflector, and that due to R, the radiation and conduction of heat from the boiler.

Let D be the width in feet of the reflector.
" p " perimeter in feet of the boiler.
" r " efficiency of silvered glass as a reflector of heat.
" s " solar constant in B.T.U. per square foot per min. = 7·12.
" a " coefficient of atmospheric transmission.
" T " absolute temperature in degrees F. of the boiler.
" A " absolute temperature in degrees F. of the reflectors.

The temperature A was found to be about 9° F. above the shade temperature of the atmosphere. Then the solar heat arriving at the absorber (considering one foot run of absorber) is H = D*sa* B.T.U. per minute.

An expression to represent the loss of heat from the boilers is less easy to obtain. The author has assumed that Stefan's law of radiation applies provided the constant k in Stefan's equation is determined under conditions almost identical with those in which we wish to apply the law. Hence R, the net heat loss by radiation *and conduction* from the boiler $= pk\ (T^4 - \frac{2}{3} A^4)$ B.T.U. per square foot per minute. The term $\frac{2}{3} A^4$ occurs because, while the boilers are sending out radiant heat, they are receiving radiant heat from the mirrors by *reason of their temperature*, and quite apart from the heat which they *reflect* on to the boilers. The $\frac{2}{3}$ is because the boilers are encircled by the mirrors for only $\frac{2}{3}$ of the perimeter of the boilers. The heating of the mirrors is due to two causes: (1) the inefficiency of the mirrors as reflectors, and (2) the heat of the air and ground.

With regard to the value of k, it fortunately happened in 1899 that the author made some very complete tests of the warming plant then recently installed in the Nurses' Home of the Hospital for Sick Children, Great Ormond Street, London. The mean temperature of the radiators was 201° F., which is to be compared with temperatures ranging from 184° F. to 235° F. of the solar boilers in Egypt, while the mean temperature of the air surrounding the radiators in the Home was 81° F. This has been taken to be equal to the surface temperature of the walls of the Home (the temperature of the air on the other side of the walls was 69° F.), and is to be compared with temperatures ranging from 95° F. to 106° F., the temperatures of the mirrors in Egypt. In the Home the air was almost motionless, while in Egypt the speed of the wind varied from 3·4 to 10·4 miles per hour, which would cause a greater loss by conduction. In both cases the hot water was contained in cast-iron vessels about $\frac{3}{8}$ in. thick, but while in the case of the radiators at the Home the surface was plain unpainted cast iron, in Egypt the cast iron was painted with a mixture of lamp-black and turps, which, while absorbing heat more readily, also radiates it more quickly. These conditions lead us to expect that the Egyptian plant was less efficient than the calculated efficiency.

Putting in the Home trial values in Stefan's equation, $R = pk\ (T^4 - A^4)$ B.T.U. per square foot per minute, and making $p = 1$ foot, we find $k = 10^{-10} \times 0{\cdot}36$ B.T.U. per square foot per minute. (This value of k differs greatly from that determined by Kurlbaum for radiation only.)

Lastly, there is the loss of solar heat due to the inefficiency of the mirrors. This is given by $M = (1 - r)Dsa$ B.T.U. per square foot per minute. Hence the equation to the efficiency of the absorber is

$$\eta = \frac{H - R - M}{H} = \frac{Dsa - pk\ (T^4 - \frac{2}{3}A^4) - (1 - r)\ Dsa}{Dsa}$$

In working out an actual case, much depends on the values selected for a and r. As a single sheet of glass stops 15 per cent. of solar heat, and as the solar radiation has to pass *twice* through the glass of a mirror, as well as to sustain a loss at the surface of the silvering, and another by some penetration of the silvering, we shall probably not be far wrong in taking $r = 0{\cdot}6$. Doing this, and using the values of 60 *sa* tabulated above, and inserting the values of the other quantities found experimentally in Egypt ($D = 12{\cdot}67$ feet, $p = 2{\cdot}92$ feet), we obtain the results given in the table on page 559.

The efficiency has not been calculated for every trial, simply on account of time and labour already expended on this paper.

The ratio $\dfrac{\text{Calculated thermal efficiency}}{\text{Actual thermal efficiency}}$ is not as constant as one would like to see it, but it must be remembered that the experiments were on a very large scale, in the open, and with an unusual number of possible variables. If we exclude the results of the naked boiler trials when the wind speed was relatively high, the mean of the rest of the ratios is 1·10, showing that on the average the calculated efficiencies are 10 per cent. too high.

It will be noticed that though the equation to the theoretical efficiency was obtained on the

No. of Trial.	Date and Hour. August, 1913.			Wind Speed. Miles per hour.		*Calculated* thermal efficiency of the Absorber, taking the solar constant = 1·93 calories sq. cm. min., the maximum atmospheric transmission = 0·7 and adjusting this for the time of day. %	*Actual* thermal efficiency (on the same basis) determined by experiment. %	Ratio of efficiencies, calculated to actual.	
1	8th.	10.15 a.m. to	11.45 a.m.	5·1	Boilers Naked.	41·4	38·6	1·07	Mean 1·15.
2	13th.	11.30 a.m. to	1. 0 p.m.	5·6		42·3	36·4	1·16	
3	,,	1. 0 p.m. to	2. 0 p.m.	5·1		41·9	35·8	1·17	
4	,,	2. 0 p.m. to	3. 0 p.m.	5·5		41·3	35·3	1·17	
5	,,	3. 0 p.m. to	4. 0 p.m.	4·5		40·3	33·3	1·21	
6	15th.	2.25 p.m. to	4.05 p.m.	7·3		34·5	14·0	2·46	Mean 2·10.
7	16th.	11.10 a.m. to	0.10 p.m.	9·6		35·6	17·2	2·07	
8	,,	0.10 p.m. to	1.10 p.m.	9·8		35·6	17·8	2·00	
9	,,	1.10 p.m. to	2.10 p.m.	10·0		36·5	19·4	1·88	
10	,,	2.10 p.m. to	2.55 p.m.	10·4		34·8	16·8	2·07	
11	22nd.	11.10 a.m. to	0.10 p.m.	4·3	Boilers Covered.	35·6	38·0	0·94	Mean 1·07.
12	,,	0.10 p.m. to	1.10 p.m.	3·5		35·6	38·4	0·93	
13	,,	1.10 p.m. to	2.10 p.m.	4·9		35·9	40·1	0·89	
14	,,	2.10 p.m. to	3.10 p.m.	4·9		. .	37·6		
15	,,	3.10 p.m. to	4.25 p.m.	4·8		. .	37·1		
16	25th.	11.15 a.m. to	0.15 p.m.	7·3		. .	27·9		
17	,,	0.15 p.m. to	1.15 p.m.	7·3		35·4	30·9	1·15	
18	,,	1.15 p.m. to	2.15 p.m.	7·2		. .	29·9		
19	,,	2.15 p.m. to	3.15 p.m.	7·0		. .	27·9		
20	,,	3.15 p.m. to	4.15 p.m.	6·6		. .	27·1		
21	27th.	10.15 a.m. to	11.15 a.m.	5·5		. .	30·1		
22	,,	11.15 a.m. to	0.15 p.m.	6·2		35·3	29·3	1·20	
23	,,	0.55 p.m. to	1.55 p.m.	5·7		33·0	31·3	1·06	
24	,,	1.55 p.m. to	2.55 p.m.	6·1		. .	31·8		
25	,,	2.55 p.m. to	3.55 p.m.	6·5		. .	29·5		
26	,,	3.55 p.m. to	4.25 p.m.	5·8		. .	24·0		
27	28th.	11.10 a.m. to	0.10 p.m.	3·9		. .	32·6		
28	,,	0.10 p.m. to	1.10 p.m.	5·1		41·3	36·0	1·15	
29	,,	1.10 p.m. to	2.10 p.m.	5·0		. .	39·3		
30	,,	2.10 p.m. to	3.10 p.m.	6·4		. .	38·4		
31	29th.	10.15 a.m. to	11.15 a.m.	3·4		. .	36·5		
32	,,	11.15 a.m. to	0.15 p.m.	4·7		41·5	35·5	1·17	
33	30th.	0.10 p.m. to	1.10 p.m.	6·5		31·4	27·4	1·14	
34	,,	1.10 p.m. to	2.10 p.m.	6·4		. .	32·0		
35	,,	2.10 p.m. to	3.10 p.m.	6·8		. .	25·7		

assumption that the boilers were naked, it has been applied to the cases in which the boilers were covered with one layer of glass, thus encasing them with warm air, which, while reducing the loss by conduction, deducts a further 15 per cent. on account of the penetration loss. The sheets of glass were simply placed edge to edge, side by side, with no jointing material, so the envelope was by no means air-tight.

Considering the results, it would appear as if the equation applied even better to covered than to naked boilers. The most divergent results are those for trials Nos. 6-10 inclusive, when the boilers were naked, and when the speed of the wind was about twice what it was during the other naked boiler trials. This is to be expected, as the wind greatly increases the loss of heat by conduction. When covered, the effect of wind is greatly reduced—compare trials Nos. 11-15 inclusive, when the wind was about 4½ miles per hour, with trials Nos. 16-20 inclusive, when the wind was 7 miles per hour.

In the author's previous paper* the actual thermal efficiencies given on the large table facing page 106 were (as the footnote there states) based on the only information he had at the time, but in the table just given they have been worked out with 1·93 calories per sq. cm. min. as the value of the solar constant, and with the coefficient of atmospheric transmission adjusted for the mean time of day of each trial. The result is that the efficiencies are much more nearly constant for each day's trials. On different days the humidity was not always the same, nor were the conditions of the boilers or mirrors.

APPENDIX III.

THEORETICAL COMMERCIAL OR OVERALL EFFICIENCY OF A SOLAR HEAT ABSORBER AND ENGINE.

It might readily be thought—in fact, it is probably a popular fallacy—that the best commercial result (or overall efficiency) obtained from a solar plant would be when the thermal efficiency of its absorber was a maximum, but this is not necessarily the case, as has been explained fully in the author's former paper (pp. 109 *et seq.*). Briefly it may be said that when a low temperature is maintained in the boiler, the difference in temperature between its outside and inside is great, and the exchange of heat is great, *i.e.*, the thermal efficiency is high. But low-temperature steam is of less value for power purposes than high-temperature steam. Thus a high commercial, or power-producing, efficiency of the plant is not necessarily associated with a high thermal efficiency of the absorber.

Hence the overall efficiency of a sun-power plant will be the product of the efficiency of the absorber into the efficiency of the engine using the steam. As different engines have different efficiencies, it is usual for engineers to compare results with a so-called "perfect," or Carnot, engine, the efficiency of which is $\frac{T - T_2}{T}$ where T is the absolute temperature of the steam, and T_2 is the absolute temperature of the condenser. T_2 has been taken as constant, and $= 568°$ F.

Hence the equation to the overall efficiency of the plant is

$$\eta_0 = \frac{\{ Dsa - pk\,(T^4 - \tfrac{2}{3}A^4) - (1-r)\,Dsa \}\,(T - 568)}{Dsa\ T}.$$

If we assume the mirrors to have a temperature of 100° F., then, by inserting the values of the other symbols (except T), we get

$$\eta_0 = 0{\cdot}71 - 1{\cdot}664 \times 10^{-12}\,T^4 - 404\,T^{-1} + 9{\cdot}45 \times 10^{-10}\,T^3.$$

Differentiating this equation with regard to T, and equating the result to 0, we obtain the value of T, which gives the maximum overall efficiency under the given conditions.

This being done, we find T = (231 + 461)° F., corresponding to a steam pressure of 21 lb. sq. in. abs. Inserting this value of T in the equation just given, we find the *theoretical* maximum overall efficiency of the Meadi absorber, combined with a

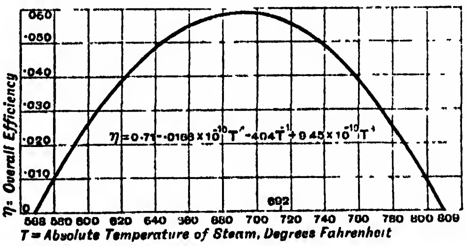

FIG. 10.—CURVE SHOWING THE RELATION OF THE OVERALL EFFICIENCY OF THE 1913 SHUMAN-BOYS SUN-HEAT ABSORBER (WITH NAKED BOILER), COMBINED WITH A CARNOT ENGINE, TO THE ABSOLUTE TEMPERATURE OF THE BOILER STEAM.

Carnot engine, is 5·9 per cent., while the *actual* maximum was 4·32 per cent. The relative efficiency was thus 73·2 per cent. This means that we obtained nearly ¾ of the b.h.p. theoretically possible under the stated conditions.

Instead of differentiating the equation to η, we may insert various values of T, and thus calculate the corresponding values of η_0 and plot the results. The temperature, which gives the maximum commercial economy, is then readily seen by inspection to be 231° F. as before. (*Vide* Fig. No. 10.) We also see that $\eta_0 = 0$ when T = 568° F. ($= T_2$, the temperature of the condenser), or when T = 809° F. The latter corresponds with a steam pressure of 131 lb. sq. in. abs., and means that the loss by radiation and conduction from the boilers and by the inefficiency of the mirrors would then be equal to the solar heat received.

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APPENDIX IV.

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DISCUSSION.

The Chairman (Charles Vernon Boys, F.R.S.), in opening the discussion, said all must be impressed by the wonderful perseverance and untiring energy of the author in preparing the paper. Anyone reading it and seeing the small proportion of the sun heat that was available—4·32 per cent.—would be disappointed that it should be so small. It was almost disheartening, but he (the Chairman) would ask the audience to consider what the position was with regard to the growing of wood and vegetables, and therefore what the position was in the growing of coal, for all vegetable matter had been produced by the aid of sun heat, and the plant had never been able to utilise anything like the 4·32 per cent. First of all, the visible spectrum of the sun was only a small proportion

of the whole energy of the sun, and then the green colour of the chlorophyll, which was the green colour of the vegetable, only absorbed out of the sun's spectrum a very small fraction of the visible spectrum, and it was only that which was available for decomposing the carbonic acid of the air and converting it into the cellulose of the plant; and it was only that which the world had ever had to rely upon for its production of wood and vegetables. Consequently all the coal available had so been produced. He could not remember what the proportion was, but it was considerably less than 4 per cent. He noticed a reference in the paper to one of the earlier inventors who talked glibly about concentrating the heat of the sun from an 85-ft. lens on to a single half inch diameter. That was a mistake which was very common. The idea was that the sun could be concentrated as much as one liked, and that all that had to be done was to make a lens big enough. For instance, if with one degree of concentration a temperature of 100 degrees was obtained, with 100 degrees of concentration 10,000 degrees of temperature could be obtained, and so on. The thing could not be done. The temperature of the sun could not be concentrated, for the reason that the diameter of the sun in the sky was, roughly speaking, half a degree, and any image produced by a lens had a definite size in relation to the size of the object. If a pocket lens were taken, that would make a minute image of the sun about as big as a pin's head, but if a large lens was employed it could not be put to the same distance. If one desired a large lens to gather much heat, it had to be put further off, and the moment that was done, although it was true that all the heat went on to the object put to receive it, the image of the sun ceased to be a thing like a small pin's head; it became larger. If a lens of 85 ft. in diameter were employed, the focus of such a lens would not be got nearer than 40 ft., and the diameter of the image of the sun would be one-hundred-and-twentieth part of that. One-hundred-and-twentieth part of 40 ft. was about 4 ins., so that the concentration of the inventor's lens of 85 ft. into an image ½ in. in diameter was on the face of it ridiculous and impossible. The author had referred to cooking by sun heat. That was an application of the heat of the sun which was far more easy and more economical than obtaining power, for the reason that, in cooking, a temperature was not required of more than the ordinary boiling-point of water and not a very great deal more than that for baking. So that moderate temperatures, which were easily obtained, were all that were required. Those moderate temperatures were not desirable when power was desired to be obtained, and that was where a real difficulty appeared—the difficulty of compromising in the sun-power plant. What was to be done? Was one going to work with a high pressure, which meant a high temperature, which meant considerable loss of heat from the boiler, in order to obtain great economy of such steam for producing power; or was one going to obtain the economy of not losing the heat from a very hot boiler, but lose it in more wastefully producing power? It had to be wasted in one way or the other, and on that question of waste the present view, both of Mr. Shuman and himself, was that all that had been done up to the present pointed to the desirability of obtaining higher pressure, and with it temperature in the boiler by somewhat greater concentration of the sun's heat; that was to say, a much larger amount of sun heat utilised in proportion to the surface of boiler heated. That brought him to another compromise. If there was very small concentration and a low temperature, one was so afraid of losing heat from the boiler that one or two glasses were put on. But supposing one went on increasing the size of the mirror in proportion to the size of the boiler; was that desirable? Supposing ten times as much heat was thrown on a boiler of a given size; if it was clothed with glass there would be reflected away by means of that glass ten times as much heat as was reflected away previously. That was not desirable, and it might be that, if only the degree of concentration were made sufficient, the increased loss due to not clothing might be less than the increased loss due to clothing, because the clothing of the boiler with glass would always reflect away a certain proportion of the heat, whereas the non-clothing of it would allow a fixed proportion for a given temperature and a greater proportion for a higher temperature. If possible, what was to be avoided was the loss as well as the inconvenience of the glass clothing, and that could best and most economically be done if only the concentration was amplified in a higher proportion than it was in the Egyptian plant.

Mr. R. W. Western said he understood the author to say that the sun-power plant, according to the latest developments, would be equivalent in a suitable climate to consumption in a steam plant of coal costing £3 10s. a ton. He presumed that estimate did not provide for depreciation of plant. The apparatus had not been in existence long enough to enable the author to have gauged what the depreciation would be, but it was no doubt large, as the plant covered a large area, was exposed to the weather, and the scantlings of which it consisted were small and would not last very long. That would be a serious drawback when comparing a solar plant with a steam plant. There was a further allowance which had to be made on the interest on the capital involved, because the obtaining of horse-power from a solar plant must involve a considerably larger capital expenditure than would be necessary to obtain it from coal. On the whole he was disappointed, because he had expected to hear that the prospects of a solar plant were rather more cheerful.

Mr. W. H. Massey said it was nearly sixty years ago since the first compound engine of which he had any knowledge was invented. The inventor was always impressed with the fact that it was much easier and more economical to cook by means of solar energy than it was to get power out of it. Several investigators, after experiment, came to the conclusion that the solar energy might be more usefully employed in the growing of vegetation, and he thought that conclusion was nearer the truth than the hopes expressed by the author. With regard to Tellier, who had been mentioned in the paper, he would like the author to say what sort of success, if any, had been obtained by Tellier.

Mr. Henry Jenkins said he had had the pleasure of hearing a paper on the same subject delivered by the author some little while previously at the Society of Engineers, and he had to confess that, as a prosaic engineer, he entered the room a little sceptical, but came out thinking very differently of sun power. As one who had seen some of the barer parts of the earth where the sun shone with great power, he could appreciate that the question of utilising sun power was getting rather close to practical politics. The amount of horse-power which had been obtained from a given area of plant in Egypt was considerable. The costs put forward, even supposing it meant that coal would have to cost £3 10*s.* a ton, in order to compete with other plant, were getting somewhere within the bounds of what could be paid in some places. For instance, in Sahara there had been a very marked desire for some time past to get a railway across the desert from Algeria down to our own railway in Nigeria. It was very important to be able to get water, which was known to exist at moderate depths below the surface in connection with that work, and a high price would be paid for a practical plant which would work by solar rays at those spots. In Chile the power had already been utilised. It had been demonstrated that low-temperature steam could, with suitable apparatus, be used to obtain quite appreciable quantities of water. He thought solar power was quite within the range of practical matters.

Mr. Walter F. Reid did not think it was quite fair to talk too much about capital, and the cost of reconstructing or keeping in repair apparatus of an experimental character, at the beginning of experiments. He did think stress ought to be laid on the fact that the sun was giving the source of the whole of the power for nothing, and when that was considered there was a very great margin left for the cost of machinery, the amortisation of capital, and so on. With reference to the Chairman's remarks, it was just possible that although a lens might not give an extremely good concentrated focus, one might do better with a mirror. He did not himself think the concentration—now that we had the electric arc and the oxy-acetylene blow-pipe, which would melt everything except carbon—of the sun's rays to the very highest temperature was a thing which was required particularly, except for scientific purposes. He thought the contrary direction ought to be taken. His opinion was that the use of water in a solar engine was a mistake. It was not a mistake in so far as it had yielded, as was seen in one of the photographs, a most ingenious boiler which was capable of being heated on both sides from a source of heat that came from one side only, but he thought the temperature of boiling water was so much above the temperature of the atmosphere that there was a very considerable loss from that alone. If a liquid were used which could be worked at a lower temperature, very much better conditions would be obtained for getting a higher yield from solar energy. With regard to the source of energy, he thought as a rule it had been accepted that the source of energy from the sun was uniform, but it appeared that that was not quite so. There was a variation. He thought the latest view of the sun was that it was a variable star, a star with a periodicity of 7 to 10 days. The heat varied from 7 to 10 days regularly, apart from the period of 11 years in which it was known to vary. The fluctuation was from 3 to 8 per cent. That was a matter to be considered, and no doubt further experiments would throw some light on it. There were means of finding out what was the actual radiation of heat from the sun by means of Fowle's spectrobolometer. By that instrument could be found out the total amount of vapour in the atmosphere between the earth and the sun, and the effect of the aqueous vapour on the transmission of heat being known, the loss through the presence of vapour could be exactly worked out. That was one of the great difficulties in our country—that there was too much vapour in the atmosphere. Even with a given amount of light it was never known how much heat was going to be got out of it. Personally he held the belief that the mechanical utilisation of solar energy would be a very great thing in the future.

Lieutenant-Colonel Allan J. C. Cunningham said a previous speaker had expressed the opinion that solar energy was better used in producing vegetation than in producing power, but he (the speaker) would like to point out that where solar energy was strongest was in hot dry climates, where vegetation could not be produced readily without plenty of irrigation; and where water was found it could only be got to the surface by some form of power. The question arose, therefore, of how to produce the necessary power for bringing it to the surface. It certainly seemed as if solar energy was being brought within measurable distance of utilisation in that connection.

Mr. C. Liddell Simpson said it had always been a question of study as to how the heat of the sun could be used. He remembered when he first

made a trip through India being struck with the amount of work which was done by the natives in raising water. If a suitable plant, worked by the heat of the sun, could be economically produced it would make a revolution in a great many of those arid deserts of India, where vegetation could only grow when irrigation was adopted. The plant at Cairo was most interesting, but the enormous space occupied by the boiler, in order to collect enough heat to give 100 h.p., seemed to put it out of the question as an ordinary commercial plant. The bodies to be interested in the matter were the Governments of India and Egypt, who should be urged to investigate the matter further in their colleges. Englishmen had given the question a good deal of study, but the thing which had held them back up to the present was that they could see no practical means of making the plant a commercial success.

Dr. John Pollen, C.I.E., said a more important subject than the one dealt with in the paper could not possibly be conceived in the interests of the people of India, and he trusted sincerely that engineers would not allow solar energy to go to waste.

The Author, in reply, said the first speaker had asked whether the figure of £3 10*s*. covered the cost of repairs and interest. The reply was in the affirmative—the £3 10*s*. covered everything. With regard to Mr. Tellier's success, he had read that gentleman's book, but could not find that he had ever made a plant; he gave most minute details of how to make one, but it could not be traced that he ever really did make one himself, and consequently he could not have experimented with it. He (the author) might mention that the best output of power per acre with the Meadi plant was on August 22nd, 1913, when there was 55½ h.p.—five times as large as had ever been obtained previously. It was equal to 63 b.h.p. per acre. The average for five hours of running on that day was 59 b.h.p. per acre, and the minimum was 52, so that the output was remarkably uniform.

On the motion of the Chairman, a vote of thanks was accorded to the author for his interesting and valuable paper.

ENGINEERING NOTES.

The War and the Railway Gauge.—The strategical importance of railways along a frontier is obvious, and, as an instance, we have the network of lines in East Prussia which has enabled the Germans to transport large bodies of troops from point to point, while the Russians, who do not possess such facilities, have found it difficult to cope with these rapid movements. The question of the difference of gauge, however, has not received the attention which its importance deserves. Outside the Pyrenees and a few unimportant places, the railway gauge throughout Europe is uniform, except in Russia, and therefore with that exception the operations of war in France, Great Britain, Belgium, Germany, Austro-Hungary, Servia, and Turkey, are untrammelled by any difference of gauge. The gauge in these countries is 4 ft. 8½ ins., in Russia it is 5 ft.—only 3½ ins. more—but it makes all the difference, and was so designed for strategical reasons. From a German and Austro-Hungarian point of view Russia is respectively on the offensive and the defensive, and is hampered by the change of gauge. Infantry and passengers tranship themselves, but guns, ammunition, cavalry, provisions, hospital stores, etc., excepting aero-craft, all have to be handled. Interruptions caused by the destruction of bridges, etc., which can always be repaired, are trifling in comparison with the obstruction due to a break of gauge. There are two points in connection with this matter, the fixed structures and the rolling-stock. The latter can take troops, etc., to the break of gauge, but if there is no train waiting to receive them they are blocked, which may or may not happen. The German advance in East Prussia against Russia, and the latter against Galicia, are on equal terms in that respect. One man's meat is another man's poison. In commerce, more or less disastrous results have followed from the divergence of gauge in India, South America, Africa, and Australia—in the last case the Government of the Commonwealth having appointed a committee who proposed unification at the cost of about £38,000,000.

Telephoning across a Continent.—Owing to public attention being so much engaged elsewhere, recent through telephoning from New York to San Francisco has escaped notice. Whoever has made this fascinating journey by train can picture to himself the varied climatic and scenic conditions through which the line passes, says a New York paper. The painstaking steps which have led to this final triumph need not be detailed here, but anyone with the most superficial knowledge of telephony must realise that it is the result of long and arduous research, of costly experiments in line construction, of profound studies in central office and substantial equipment, and of fatigue and of discomforts sustained by many men through heat and cold. It is hardly to be expected that trans-continental telephony will become a popular diversion at a cost of something like £5 for a three minutes' conversation between New York and San Francisco, but the amount of plant at the disposal of the subscribers, involving approximately 3,000 tons of copper wire and 130,000 poles, in addition to the transmitting and receiving apparatus, switchboard, auxiliaries, etc., explains to some extent the cost of a temporary exclusive right of way across the United States. Probably the greatest gain will be to users of intermediate toll service, and the linking of Chicago, Denver, and other cities, with the Pacific coast will do much to expedite important business by telephone, and tie together great areas until very recently only on the frontiers of this form of communication. It was a happy circumstance that the veterans Dr.

Alexander Graham Bell and Thomas A. Watson, participants in the first telephone conversation in the world some thirty-eight years ago, exchanged greetings over the new lines.

Large Diesel Engine.—The largest Diesel engine yet constructed to a definite order, states the *Times*, has recently been completed by Messrs. Sulzer Brothers, of Winterthur, Switzerland, and successful tests have been carried out. Motors of higher power have been built by two firms in Germany, but up to the present they have reached only the experimental stage. The new engine is of the two-cycle single-acting type, with six cylinders, and was designed to develop 3,750 b.h.p. at 142 r.p.m., though on trials a power of 4,500 b.h.p., or about 750 b.h.p. per cylinder, was maintained for a long period. It was built for Messrs. Harland and Wolff, of Belfast, and is to be employed in generating electricity for light and power in the shops, although there is a possibility that its installation may lead to a similar type of motor being developed for marine work in this country. The cylinder dimensions are 750 mm. bore and 1,000 mm. stroke (about 29·5 ins. by 39·4 ins.), and in general design the motor is of the marine type, being somewhat similar to the 850 h.p. engines installed in the motor-ship "Monte-Penedo," and also to two sets of 1,600 b.h.p. each, built for a British naval tank ship. There are two scavenge pumps driven directly off the crank shaft, and the scavenging air is admitted to the working cylinders through two sets of ports at the bottom. The main ports are opposite the exhaust ports, and occupy half the periphery, while the auxiliary scavenging ports are above, the air being admitted to them after the piston has covered the bottom set in its upward stroke. For each cylinder there is a valve in the main scavenging pipe controlling the passage of the air to the auxiliary ports. The cylinder covers are supported by means of steel columns, which take the main stresses due to the high pressure, and the cylinders are hung from the covers, being therefore free to expand longitudinally. Another modification is that the governor of the engine is arranged to control the air inlet of the air-compressor and the time of opening the fuel valve, as well as the stroke of the fuel pump. By this means the engine is enabled to run satisfactorily at low powers.

Painters' Colours and Materials.—Germany will lose heavily through the war in this particular trade. In 1912 Germany, says the *Engineer*, exported to all destinations, painters' colours and materials to the value of £3,162,000. This country was by far the best customer of Germany for these goods, the exports to the United Kingdom being £791,000, or 25 per cent. of the total. This market is now lost to Germany, and the loss is likely to be a permanent one, as British paint and colour manufacturers, says a contemporary, are now successfully making almost all the materials which hitherto have been supplied from the Continent. It may safely be assumed that Germany's paint and colour trade with British possessions, which amounted in 1912 to over £80,000, will now be transferred to this country. It is also reasonable to suppose that our manufacturers will be able to capture a large proportion of Germany's trade with France in similar goods, amounting to £180,000, and with Russia, amounting to £150,000. Germany is also cut off from the United States market, to which in 1912 she sent paints and colours to the value of over £300,000, and from the South American markets to which her exports of the same class were of the value of £120,000. In these markets British manufacturers have openings and opportunities such as they never had before, and are not likely to have again.

Concrete in Waterworks Construction.—Amongst other things, the behaviour of water in concrete is constantly mooted, and the following, recently read by Professor Edgar B. Kay, a leading authority on the question, to the American Waterworks Association, will be read with interest. The quotation is from "Ferro-Concrete":—

"*Sand.*—Tests have shown conclusively that sand with rounded grains makes quite as strong a mortar, other things being equal, as does sand with angular grains. A fine sand makes a weaker mortar than a coarse, because of the lower density. The only substitute for natural sand for concrete that need be considered is pulverised stone, either dust and fine screenings produced in crushing rock, or an artificial sand made by reducing suitable rocks to powder. *Stone Dust.* -- The danger of using stone dust is failure to secure the proper balance of large-sized grains. The coarseness as well as the fineness of a good concrete sand is limited. The best sands will show not more than 40 per cent. retained on a No. 10 sieve, and not more than 5 per cent. passing a No. 80 sieve. *Grading Aggregates.* — Upon large or important structures it pays to make careful studies of the materials of the aggregates and their relative proportions. Mr. W. B. Fuller has shown that by changing the ordinary mixture of watertight concrete, and by carefully grading the materials, he was able to obtain watertight work while effecting a saving of 0·36 barrel of cement per cubic yard of concrete. *Watertight Concrete.*—A wall of concrete may be rendered watertight by accurately grading and proportioning the aggregates and the cement. For maximum watertightness, a mortar or concrete may require a slightly larger proportion of fine grains in the sand than for maximum density or strength. In general it may be stated that in monolithic construction a wet mixture, a rich concrete and an aggregate proportioned to secure great density, will in the majority of cases, give the desired results." This method is unquestionably the best to secure watertightness, and the Professor is not in favour of using waterproofing ingredients or of making surface applications except in cases where they may be required by reason of imperfections in the original concrete.

GENERAL NOTES.

Chinese Market for Machinery.—The following articles imported from Hankow have, according to H.M. Consul-General at that port, hitherto been largely of German or Austrian origin: Machinery of all kinds, small tools, hardware, such as galvanised, corrugated, and flat sheets, wire nails, rods and bars of various sections, window glass, nail rods, copper and brass bars, and sheets, needles, Berlin wool, braid, buttons, ribbons, trimmings, lamps, soaps, wash-basins and enamelled ware, aniline dyes, chemical products, electrical material and fittings, cups and saucers, and generally small metal goods of inferior quality and low price. German manufactured piece-goods and fancies imported at Hankow consist chiefly of cheap waste-cotton printed blankets and small sundries such as baby-caps, men's vests, caps and hats, etc. Cotton trouserings are imported also from Austria and Italy. Most of the trade in imported goods is done with dealers in Hankow, and the exploitation of the interior and treaty ports further removed from the coast is left entirely to them. There is no doubt that the business could be much expanded if this exploitation could be undertaken to a larger extent by foreigners. The (merchant) firms in China are not in a very good position to do this, unless they are materially assisted by manufacturers and exporters at home. Some goods, of course, lend themselves better than others to this treatment. Certain firms have been very successful in organising up-country agencies under Chinese merchants for the sale of sowing machines, knitting machines, patent medicines, and the like. Many other articles could also find an extended market in this way. It would, of course, be essential that the goods should be sent out on consignment to agents. German manufacturers seem to be more alive to the requirements of the Chinese market, and to be more willing to assist the merchant on the spot. The machinery trade affords an example of this. Much machinery of British origin has been imported through German firms, but the latter also represent German manufacturers, and are naturally prone to push German in preference to British goods wherever possible.

Indian Crops.—The April number of the *Bulletin of Agricultural and Commercial Statistics* publishes figures for the crops recently harvested in India. The wheat crop for 1914–15 was 104,581,718 quintals, 123 per cent. of that for the preceding season. The rice harvest is estimated at 284,125,351 quintals of husked rice as against 292,522,979 quintals in 1913–14, or 97 per cent., and the yield of cotton was 9,492,752 quintals as against 9,189,733 in 1913–14, or 103 per cent.

Wheat in Burma.—Recent experimental work in Burma encourages the hope that in years to come this country will be numbered among the wheat-producing provinces. From the annual report of the local agricultural department for 1914 it appears that work in connection with selection of wheat for seed purposes has been carried on at Mandalay, and that the farms at Padu in the Sagaing District and Hopin in the Myitkina District will enable this crop to be taken up in earnest. It is satisfactory to learn that success has been obtained as far north as Myitkina, and the hope is expressed that the introduction of this new staple to the cultivator of Northern Burma will not be long delayed. In the Shan States no great developments are to be expected until the completion of the railway to Yawnghwe, but thereafter large areas should come under wheat, as the soil and climate are favourable. The farms of the agricultural department will find out what types are specially suitable for cultivation.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock:—

May 5. — Augustus Vernon Harcourt, D.C.L., LL.D., D.Sc., F.R.S., "On the Measurement of the Efficiency of Domestic Fires, and on a Simple and Smokeless Grate." Francis William Goodenough, M.Inst. Gas Engineers (Gas Light and Coke Co.), will preside.

May 12.—Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry." Sir Robert Abbott Hadfield, D.Sc., F.R.S., will preside.

Additional Lecture.

Thursday afternoon, at 4.30 o'clock:—

May 6.—M. Paul Lambotte, Directeur des Beaux-Arts au Ministère des Sciences et des Arts de Belgique, "Constantin Meunier et les Sculpteurs Belges de son Temps." Lord Sanderson, G.C.B., K.C.M.G., will preside.

Indian Section.

Thursday afternoon, at 4.30 o'clock:—

May 13.—Sir Charles H. Armstrong, late Chairman, Bombay Chamber of Commerce, "Indian Trade and the War." The Most Hon. the Marquess of Crewe, K.G., P.C., Secretary of State for India, will preside.

Colonial Section.

Tuesday afternoon, at 4.30 o'clock:—

May 4.—S. Chas. Phillips, M.S.C.I., "The Empire's Resources in Paper-making Materials." The Hon. Sir George H. Perley, K.C.M.G., Member of the Canadian Government, will preside.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

David Sommerville, B.A., M.Sc., M.D., M.R.C.P., D.P.H., Assistant Professor of Hygiene and Public Health, University of London, King's College, "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

Syllabus.

Chemical Constitution of Foodstuffs—Proteins—Carbohydrates — Fats — Inorganic Substances — Colloids and Crystalloids—Metabolism—Enzymic Action in the Alimentary Canal.

MEETINGS FOR THE ENSUING WEEK.

Monday, May 3 ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Dr. D. Sommerville, "Foodstuffs." (Lecture II.)

Victoria Institute, Central Hall, Westminster, S.W., 4.30 p.m. Rev. W. St. Clair Tisdall, "Mahâyâna Buddhism and Christianity."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Chemical Industry, Society of (London Section), at the Chemical Society, Burlington House, W., 8 p.m.

Surveyors' Institution, 12, Great George-street, S.W., 7 p.m. (Junior Meeting.) Annual General Meeting.

British Architects, Royal Institute of, 9, Conduit-street, W., 8 p.m. Annual General Meeting.

Tuesday, May 4...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4.30 p.m. (Colonial Section.) Mr. S. C. Phillips, "The Empire's Resoures in Paper-making Materials."

Rontgen Society, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 8.15 p.m.

Asiatic Society, 22, Albemarle-street, W., 4 p.m. Professor Inayat Khan, "Indian Music," accompanied by the "Royal Musicians of Hindustan."

Royal Institution, Albemarle-street, W., 3 p.m. Professor C. S. Sherrington, "The Animal Spirits." (Lecture I.)

Alpine Club, 23, Savile-row, W., 8.30 p.m. Dr. W. H. Workman, "The Mountaineering Aspect of Himalayan Glaciers."

Roman Studies, Society for the Promotion of, at the Society of Antiquaries, Burlington House, W., 4.30 p.m. 1. Annual General Meeting. 2. Professor Haverfield, "Roman Conceptions of Empire."

Photographic Society, 35, Russell-square, W.C., 8 p.m. Dr. F. Penrose, "The Use of Autochromes in Bird Photography with Examples of Protective Coloration."

Wednesday, May 5...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Dr. A. V. Harcourt, "The Measurement of the Efficiency of Domestic Fires, and on a Simple and Smokeless Grate."

Civil Engineers of Ireland, Institution of, 35, Dawson-street, Dublin, 8 p.m.

Public Analysts, Society of, at the Chemical Society, Burlington House, W., 8 p.m. Joint meeting with the Biochemical Society to discuss the "Methods adopted in the Estimation of the Nitrogenous Constituents of Extracts derived from Albuminous Substances, such as Meat Extracts and similar products, with special reference to the interpretation of the results."

Royal Archæological Institute, at the Society of Antiquaries, Burlington House, W., 4.30 p.m. Mr. A. H. Allcroft, "Some New Light on Roman Roads in Sussex."

Thursday, May 6...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4.30 p.m. (Special Lecture.) M. Paul Lambotte, "Constantin Meunier et les Sculpteurs Belges de son Temps."

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Linnean Society, Burlington House, W., 5 p.m. 1. Mr. W. P. Westell, "Some Bird Problems." 2. Dr. Sarah M. Baker and Miss M. H. Bohling, "On the Brown Seaweeds of the Salt-Marsh." (Part II.) 3. Mr. H. N. Dixon, "On a collection of Borneo Mosses made by the Rev. C. H. Binstead." 4. Rev. T. R. R. Stebbing, "Photographs of a curiously-grown tree from a Tunbridge Wells garden."

Chemical Society, Burlington House, W., 8.30 p.m. 1. Messrs. T. M. Lowry and T. W. Dickson, "The rotatory dispersive power of organic compounds. Part VI.—Complex rotatory dispersion in ethyl tartrate." 2. Messrs. T. M. Lowry and H. H. Abram, "The rotatory dispersive power of organic compounds. Part VII.—Complex rotatory dispersion in methyl tartrate." 3. Messrs. M. Jones and J. R. Partington, "Experiments on supersaturated solutions." 4. Messrs. C. S. Gibson and J. L. Simonsen, (*a*) "Sulphonyl and carbonyl derivatives of alanine. Resolution of externally compensated p-toluenesulphonylalanine into its optically active components"; (*b*) "The resolution of externally compensated tetrahydro-β-naphthoquinaldine into its optically active components"; (*c*) "The non-resolution of di-tetrahydro-β-naphthoquinaldine by means of d-oxymethylenecamphor." 5. Mr. J. L. Simonsen, "Syntheses with the aid of monochloromethyl ether. Part III.—The action of monochloromethyl ether on the sodium derivatives of ethyl ethaneαββtricarboxylate, ethyl butaneααδδtetracarboxylate, and ethyl pentaneααγγtetracarboxylate." 6. Messrs. J. L. Simonsen and M. Nayak, (*a*) "The nitration of 3-acetylamino-2-methoxy toluene"; (*b*) "Condensation of ethyl cyanoacetate and acetyl acetone."

Royal Institution, Albemarle-street, W., 3 p.m. Dr. A. W. Porter, "Advances in General Physics." (Lecture II.)

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mr. T. E. Peet, "Abydos, an Egyptian Sacred City."

Concrete Institute, 296, Vauxhall Bridge-road, S.W., 7.30 p.m. 1. Annual General Meeting. 2. Discussion on Mr. O. C. Hill's paper, "The London Building Acts with some suggested Amendments."

Friday, May 7...Royal Institution, Albemarle-street, W., 9 p.m. Professor O. W. Richardson, "Electrons and Heat."

Historical Society, 22, Russell-square, W.C., 8.30 p.m. Mr. H. J. Mackinder, "The Historical Geography of the Hungarian Plain."

Geologists' Association, University College, W.C., 8 p.m.

Textile Institute, 16, St. Mary's Parsonage, Manchester. Annual Spring Meeting and Conference.

Saturday, May 8...Royal Institution, Albemarle-street, W., 3 p.m. (Tyndall Lecture II.) Professor J. A. Fleming, "Photo-Electricity."

Journal of the Royal Society of Arts.

No. 3,259. VOL. LXIII.

FRIDAY, MAY 7, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MAY 10th, 8 p.m. (Cantor Lecture.) DAVID SOMMERVILLE, B.A., M.Sc., M.D., M.R.C.P., D.P.H., Assistant Professor of Hygiene and Public Health, University of London, King's College, "Foodstuffs." (Lecture III.)

WEDNESDAY, MAY 12th, 8 p.m. (Ordinary Meeting.) CHARLES R. DARLING, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry." SIR ROBERT ABBOTT HADFIELD, D.Sc., F.R.S., will preside.

THURSDAY, MAY 13th, 4.30 p.m. (Indian Section.) SIR CHARLES H. ARMSTRONG, late Chairman, Bombay Chamber of Commerce, "Indian Trade and the War." The Most Hon. the MARQUESS OF CREWE, K.G., P.C., Secretary of State for India, will preside.

Further particulars of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, May 3rd, DR. DAVID SOMMERVILLE, B.A., M.Sc., M.R.C.P., D.P.H., Assistant Professor of Hygiene and Public Health, University of London, King's College, delivered the second lecture of his course on "Foodstuffs."

The lectures will be published in the *Journal* during the summer recess.

COLONIAL SECTION.

Tuesday afternoon, May 4th; The Hon. SIR SIR GEORGE H. PERLEY, K.C.M.G., in the chair. A paper on "The Empire's Resources in Paper-making Materials" was read by Mr. S. CHAS. PHILLIPS, M.S.C.I.

The paper and discussion will be published in a subsequent number of the *Journal.*

EXAMINATIONS, 1916.

The arrangements for 1916 will be similar to those of 1915, and two examinations will be held in all three stages. The first examination will commence on April 10th, and finish on the 19th. The second will commence on May 29th, and finish on June 7th. The last days for receiving entries will be March 13th and April 28th.

The time-tables will be published later.

BARRY'S PICTURE OF "ADAM AND EVE."

The picture of "Adam and Eve," by James Barry, R.A., which has been on loan at the South Kensington Museum (now the Victoria and Albert Museum) since 1856, has been presented by the Society to the National Gallery of Ireland, and has been accepted by the Governors and Guardians of that Institution.

Barry was born in Cork, in 1741. His principal work is the series of paintings in the Society's Meeting Room, and not many of his other paintings are now known to be in existence. There are very few specimens of his work in any of the London public galleries, and these are all portraits. There is an unfinished portrait of Dr. Johnson in the National Portrait Gallery, evidently a study for the portrait in the group in the artist's picture, "The Society." There are also portraits of himself in the Victoria and Albert Museum and in the National Portrait Gallery.

The "Adam and Eve" was painted in Rome, and was exhibited, after Barry's return to England in 1770, in 1771 at the Royal Academy, this being the first picture shown by him at the Academy. When, after his death, his works were sold at Christie's in 1807, the "Adam and Eve" was purchased for 110 guineas. The name of the purchaser does not appear to have been recorded. The Society possesses an etching of the picture by

Barry. The title is given on the plate as "The Temptation of Adam."

In 1834 the picture was presented to the Society by Mr. Richard Horsman Solly, and the following entry appears in the Society's Minutes under the date of November 12th, 1834:—

"A letter was read from R. H. Solly, Esq., stating that he had sent to the Society for exhibition on Tuesday (the evening of the first Illustration this Session) a picture painted by the late James Barry, Esq. (Adam and Eve), and should the Society wish to possess it, he should have much pleasure in presenting it to them.

"A motion was made by Mr. Moore, and seconded by Mr. Winkworth, that the warmest thanks of this Society be presented to Mr. Solly for this additional proof of his liberality and good wishes towards the Society."

Mr. R. H. Solly, who died in 1858, was a very active member of the Society, and it was due mainly to his exertions that the Society from 1831 onwards did a great deal to encourage improvements in the construction of telescopes and microscopes.

PROCEEDINGS OF THE SOCIETY.

NINETEENTH ORDINARY MEETING.

Wednesday, May 5th, 1915; FRANCIS WILLIAM GOODENOUGH, M.Inst. Gas Engineers (Gas Light and Coke Company), in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Amenomori, Kikutaro, Nakanocho, Higashi-Sambongi, Kyoto, Japan.

Armstrong, Sir Walter, Hon. R.H.A., 63, Carlisle Mansions, Victoria-street, S.W.

Grant, Alfred Charles, Montego Bay, Jamaica, British West Indies.

Khan, Haziq-ul-Mulk Hakim Mahomed Ajmal, K.I.H., President, Anjuman-i-Tibbia, Delhi, India.

Mishra, Pandita Damodardas, Hardwar, United Provinces, India.

The following candidates were balloted for and duly elected Fellows of the Society:—

Baw, U. Kan, K.I.H., Pyinmana, Yamathin District, Burma.

Bright, Charles, F.R.S.E., M.Inst.C.E., M.Inst. E.E., Members' Mansions, Victoria-street, S.W.; and The Grange, Leigh, Kent.

Griffin, Louis T., The Auckland Museum, Auckland, New Zealand.

Humphrys, Claude William Erskine, Penang Rubber Estates Co., Ltd., Province Wellesley, Penang, Straits Settlements.

The paper read was—

ON THE MEASUREMENT OF THE EFFICIENCY OF DOMESTIC FIRES, AND ON A SIMPLE AND SMOKELESS GRATE.

By AUGUSTUS VERNON HARCOURT, D.C.L., LL.D., D.Sc., F.R.S.

Several months ago a friend told me that he had got a box of some stuff which would make one ton of coal go as far as two. Would I come and see it tried?

I found that the box was a cardboard box holding about half a pint of a pink powder. A heaped teaspoonful of the powder was to be stirred up in a pint of water and three scuttles full of coal sprinkled with this mixture. The disproportion between the size and number of the lumps of coal and the teaspoonful of powder which was to be distributed over their surface was so great that it was difficult for anyone whose business has been experimental chemistry to go through this sprinkling seriously. However, it was done, and has been done for me many times since. But neither then nor in subsequent trials, using a grate well adapted for such observations, could any material difference be found in the rate of burning with and without the powder. What difference there is seems to be due to the water, which is used as a means of distributing the powder. If coke be thoroughly wetted, it absorbs a large volume of water, and the life of the fire is much lengthened; with a feeble draught it might even be doubled; but with lumps of coal the effect is much less.

Since the pink powder consists chiefly of common salt, the effect of dissolving a quantity of salt in the water was tried, but no further diminution in the rate of combustion was observed.* A salt more fixed in the fire, such as sodium sulphate, would doubtless be more efficient; but some heat is lost if coal or coke is wetted, and in an open grate neither needs to have its combustibility diminished unless there is an unusually strong draught. When this is the case, an admixture of breeze or small coal, of which there is generally more than

* An analysis of the powder made for me by Mr. R. E. Steel, Natural Science Master at Sherborne School, gave the following result:—

Sodium chloride	83·85
Calcium carbonate	8·71
Ferric oxide	2·88
Silica	0·69
Water	3·57
	99·70

enough in a coal cellar, will check the draught and reduce the rate of burning.

There remains the question of the output of heat. Chemists, and, indeed, everyone who has a little knowledge of chemistry, will agree that the total amount of heat caused by the combustion of a pound of coal will not be increased by the addition to it of rather less than one grain—that is, one seven-thousandth part—of any kind of incombustible material.* But it may be rightly objected that it is not the total amount of heat which concerns the householder, but the amount of heat radiated into a room, and this cannot be so easily and exactly measured. A minute proportion of common salt in the air around an atmospheric burner enormously increases the light radiated from it. Why should not the same agent cause some corresponding increase in the heat radiated from a lump of coal?

The desire to settle this question, by measuring the amount of heat radiated into a room, led me to design, and have made, a little instrument for the purpose, and, having worked with it, to offer to your Society an account of the instrument and the results, and at the same time to bring before you a form of grate, the more remote and the immediate ancestors of which have added to my comfort for some forty years, but whose efficiency with various fuel I have only measured in the last few months.

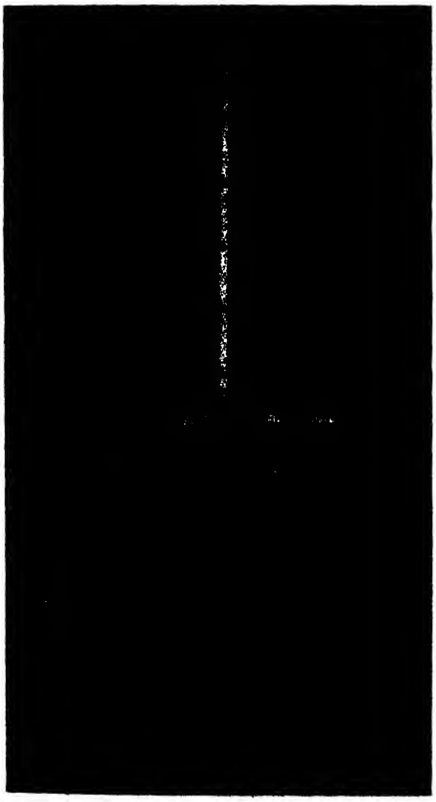

FIG. 1.—THE RADIO-THERMOMETER.

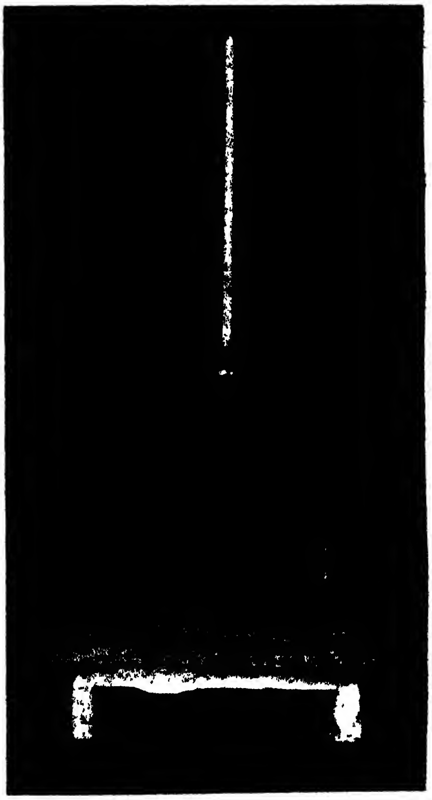

FIG. 2.—COPPER BOX OF RADIO-THERMOMETER, WITH WOODEN BOX AND PACKING BENEATH.

The instrument which, for want of a shorter name, I call a radio-thermometer—that is, measurer of radiant heat—consists of a copper box, 6 ins. × 6 ins. × 1 in., with a small funnel-shaped inlet, enclosed in a wooden box, 7 ins. × 7 ins. × 2 ins., open at the top and with an opening 5 ins. square in the middle of one side. Except on this side there is a space between the two boxes, of an inch at the back and half an inch at the sides and below, which is loosely packed with cotton-wool. Of the side which is in contact with the wood the central 25 square inches is exposed and has been blackened. A

* One heaped-up teaspoonful is to be sprinked over one hundredweight of coal or coke. Four heaped-up teaspoonfuls weigh about one ounce, whence approximately 64 weigh one pound, and 7,168 one hundredweight.

thermometer is held by a cork in the opening at top, and this is also used as a stirrer, being furnished with a cup-shaped piece of rubber sheet tied on above the bulb, which stretches across the box.

The weight of the copper box is 11 oz., that of the water which fills it is 1 lb. 6 oz. The water-equivalent of the copper box is 11 × ·095 = 1·045 oz. Hence the mass of water heated may be taken as 1 lb. 7·04 oz., or 1·44 lb. The instrument having been freshly filled with cold water, is placed facing the middle of the fire at a distance of 3 ft. Exactly at some minute by the watch the thermometer is read. About nine

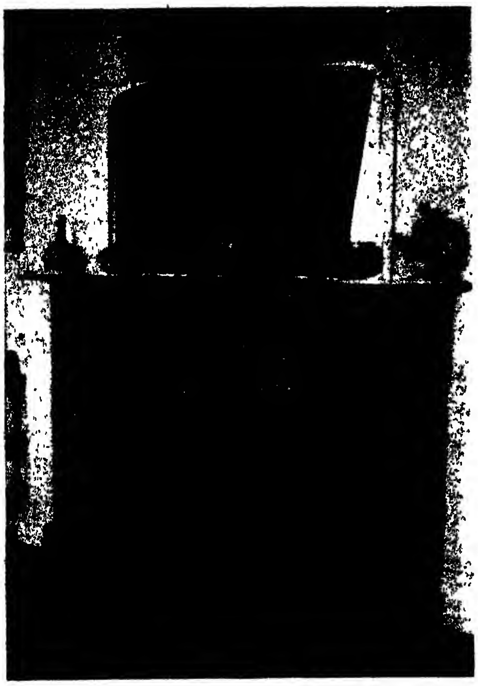

Fig. 3.—A Grate in which the Fire is drawn up by hanging plates.

minutes later the water is briskly stirred up and down with the thermometer, which is then replaced with its bulb central, and at the end of ten minutes the thermometer is again read. These readings are repeated every ten minutes until the temperature of the water is as much above the temperature of the air, taken by a thermometer at the back of the instrument, as it was below it at starting. The cotton-wool, which checks the flow of air round the box, prevents the temperature of the air of the room having much influence, and both this and the exchange of radiations are approximately balanced by the temperature of the water being to an equal extent, and for nearly the same time, first lower, then higher, than that of its surroundings.

A set of observations thus made generally occupies nearly an hour, and gives an average result for that period. To make the results, when at different times the fire was larger or smaller, more comparable, an estimate was made, every ten minutes, of the area of fire from which the chief part of the heat was being radiated, as being so many spaces. The bars being 18 ins. long with 2 ins. between them, a space was 36 square inches. Though each estimate was only approximate the average will not have been far wrong.

An example will show the plan which has been followed:—

February 25th, 1915. Barometer, 30·2. Temperature of air in room, 57°·0. Grate charged with coke. Fire lit at 8 a.m.

Time.	Temp.	Rise in 10 mins.	Spaces.	Balance of Temperatures.	
	°F.	°F.		°F.	°F.
IX. 26	35·8	..	3·0		
36	41·6	5·8	3·3	57·0	78·5
46	48·0	6·4	3·5	35·8	57·0
56	54·7	6·7	4·0	21·2	21·5
X. 6	62·2	7·5	4·3		
16	70·4	8·2	5·0		
26	78·5	8·1	5·0		
Average . .		7·12	4·0	Average rise for 1 space	1°·78

The heat radiated from 36 square inches of fire-front, corresponding to a square 6 inches in the side, upon a surface of 25 square inches, at a distance of 3 feet, in ten minutes, raised the temperature of 1·44 lb. of water 1°·78 F. Since all these measures but the last are constants of the method, the result may be called 1·78 units.

If these units, which serve for the comparison of one grate or one fuel with another, are multiplied by 25·2, the total amount of heat sent into the room every minute from each 6 inches square of the front of the fire, is given in British Thermal Units.*

* $\frac{1\cdot44\times175}{10} = 25\cdot2$. Multiplication by 1·44 increases the result to what it would have been if only 1 lb. of water had been heated. Division by 10 reduces it to what it would have been if the heat had only been applied for one minute. 175 is an approximate estimate, furnished me by Mr. Sydney Lupton, of the number by which the heat falling normally upon a surface of 25 square inches must be multiplied to represent the total heat radiated in front of the fire in every direction.

A large number of measurements have been made of heat radiated from coal and from coke, and from coke which had been wetted, and from coal and coke treated with the pink powder in the manner prescribed. The grate chiefly used was that of which I have here an example, whose division into many spaces and flat vertical front adapt it for this purpose. The whole charge of fuel is put in at once, and heaped up above the top bar into the throat of the chimney before the fire is lit. The fire burns gradually downwards, like a candle, and lasts the day through.

The average results, in units of the method, are as follows: Coke, 1·97; coal, 1·63; wet coke, 1·29; coke or coal sprinkled with water and powder, 2·03. The numerical results are given, but must only be regarded as rough approximations indicating little more than the order of magnitude. The precaution was taken of allowing the fire to burn for some time before measurements were made, both that the chimney might have attained its full temperature, and that a sufficient space might intervene between the top of the fire and the opening of the chimney to lessen the effect of the draught up the chimney. Even so, the effect of wind—and probably also, though in a less degree, of outdoor temperatures and moisture—is such that observations would need to be made over a long period if a more accurate average were necessary.

The actual results are intelligible and probable. Coal when it burns passes through two distinct stages. First it gives off gas, some of which burns, while some, not coming in contact with anything sufficiently hot or being mixed with too much steam or nitrogen, escapes unburnt. When evolution of gas has ceased the coal has been changed to coke, and the second stage begins. Thenceforward it burns with a steady glow. Much less heat is radiated out during the first stage than during the second; the heat from the burning gases goes chiefly up the chimney. Thus when the heat from a coal fire is fairly measured, some parts being in one stage and some in the other, the result is lower than when all is in the second stage or, which is the same thing, when coke is being burnt. Wet coke, if sufficiently wet, gives still less heat at any moment, for it burns more slowly and some of its heat goes to evaporate the water. When the fire is dull-red the steam from water beneath escapes and makes no sign, but when the upper part is glowing brightly the steam is successively decomposed and recomposed, the pale flame of hydrogen, though mixed with an equal volume of carbonic oxide, being distinguishable from the blue flame of carbonic oxide, which air without steam produces.

Coke treated with powder or untreated radiates practically the same amount of heat, a result which will not surprise members of this Society.

I remember another little box much in demand sixty or more years ago. It was filled with little bottles containing homœopathic globules which good people took and gave to their friends, having a confident belief in the

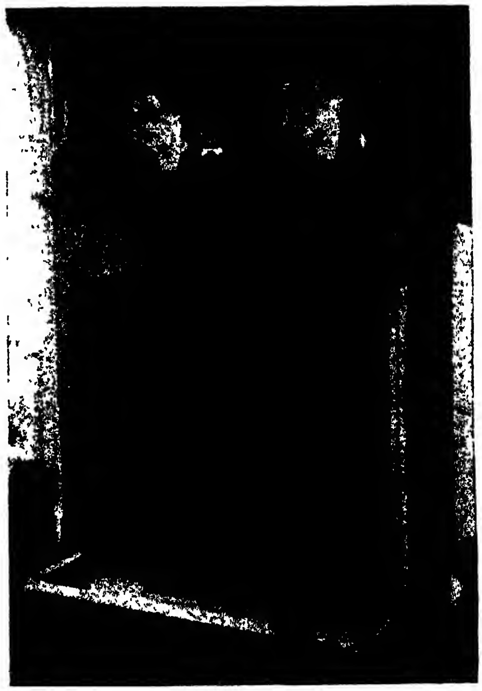

Fig. 4.—A Grate charged and ready for Lighting.

benefits which followed. In that case, as with other more plausible drugs, the belief could not readily be put to the test of comparative experiment. In the case of a physical agent, this test is readily though not commonly applied. It seems that we are not wiser than were, according to Mr. Kipling, "Our fathers of old."

Bulk for bulk, coal is nearly twice as heavy as coke, burns for longer under the same conditions, produces more heat, and from an open grate radiates rather more heat, because it lasts longer.

Weight for weight, coke has the advantage for domestic use, and would retain it even if through increased demand the price of the two were the same.

If public benefit can be brought into account, the advantage of the use of coke for domestic fires is very great. The fires are smokeless. I hope some member of the Smoke Abatement Society may be here who will tell us how London and other great residential cities and towns would benefit if the chimneys of houses sent out no smoke. Nearly one-quarter of the coal consumed in the United Kingdom is burnt in domestic fires.

The grate of which, in conclusion, I have still to give a description, or rather one of its predecessors on the same principle, was used with coal only for many years, and used to be nearly smokeless after the first hour. By that time the top layer of coal had passed through its first stage of flame and smoke, and had become a layer of glowing coke. Through this layer the gases given off as the heat spread to the coal beneath, with their light burden of particles of soot, had to pass on their way to the chimney; all that was combustible, whether gas or soot, was burnt, and thenceforward for the rest of the day the fire was smokeless. A few years ago it occurred to me that it might be well to mix coke with the coal; the proportion of coke was gradually increased, and latterly I have used coke only, excepting that for lighting the fire a few pieces of coal are helpful, as well as paper and wood.

Where a fire is needed for a short time only a gas fire is best. One of these, with good pressure and a consumption of about 35 cubic feet of gas per hour, gave as much heat as three spaces of the coke fire, or as a good drawing-room fire of the ordinary type. For equal times of burning, the cost of the gas fire is much greater. The charge of coke which fills the grate and maintains a good fire for fourteen hours, as from 8 a.m. to 10 p.m., is 34 lbs., which, with coke at a peace price of 18*s.* per ton, costs only 3¼*d.* Gas giving as good a heat, and burning at the rate of 35 cubic feet per hour for the same time, would, at the rate of 2*s.* 6*d.* per thousand cubic feet, cost nearly 1*s.* 3*d.* But when a fire is needed for only half an hour or an hour, as in a dressing-room, the immediate lighting and extinguishing, together with the

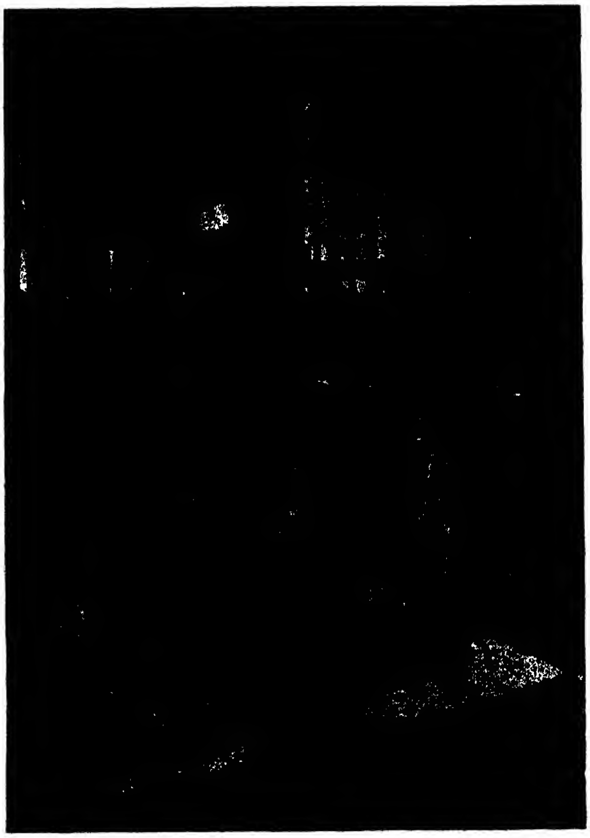

FIG. 5.—GRATE WITH SURROUNDINGS.

absence of all trouble of emptying ashes, cleaning, laying and lighting, turns the scale in favour of gas.

In the construction of a grate to yield as much radiant heat as possible from the fuel consumed, certain principles should be observed: (1) The face of the fire should be vertical, so that the chief radiation should be horizontal, not directed upwards towards the chimney and the ceiling; (2) the bars should be as slight as is compatible with sufficient strength, and as wide apart as will suffice to prevent more than an occasional ember falling out; the reason is that the bars do not reach a red heat, nor radiate so much heat as an equal surface of the fire behind them, and to the extent of the difference they act as screens; (3) for a similar reason the fire should be narrow from back to front. A space of 4 or 4½ inches between the back and the bars is enough; only the glowing surfaces which can be seen from in front radiate heat into a room, and lumps of fuel which hide other lumps and the red-hot firebrick behind them, act as screens, whether they themselves are dark or glowing; (4) air should pass in through bars in front, not through bars beneath; for the most vivid combustion occurs where the air and fuel meet. If this is at the bottom of the fire, much heat is radiated on to the hearthstone below, and helps to send a current of heated air up through the fire, promoting the burning of the coal, but not to good purpose; (5) to save the trouble of frequent attention and replenishing from a coal-scuttle during the day, and to avoid smoke, it is well to put in at once all the fuel the fire will need and to light it at top; (6) coke burns down more quickly than coal, and thus, especially with coke which has been "graded" and the light combustible coke from vertical retorts, the fire may reach its full heat near the middle of the day when its services are less needed than earlier or later. Control of the fire can be obtained by means of an iron plate put in when the fire is being laid, half-way up, resting on two or three lumps of coke only, that air may circulate underneath and prevent it becoming so hot as to ignite the coke beneath. When the fire is low the plate is pulled out, and the lower half of the fire makes a fresh start; (7) some means are needed for drawing up the fire when it is low. Either plates may be hung on one beneath the other, or folding doors may be arranged to close the upper part of the grate,

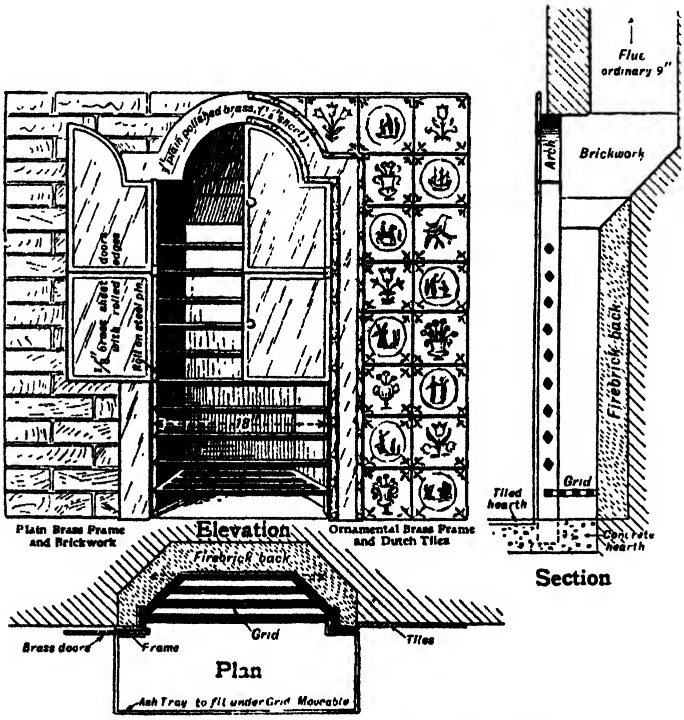

FIG. 6.—DESIGN OF FLAT GRATE BY MR. KITCHIN.

and so concentrate the pull of the chimney upon the face of the fire beneath.

The grates, of which various illustrations will be shown, have been constructed on these principles. A serious difficulty has had to be met, for which there is no scientific solution. The grate must not be less attractive in appearance than other grates. Its simple character and the unavoidable display of a large unrelieved surface of coke or coal make this difficult. I appealed, but unsuccessfully, to a well-known artist who has professed a keen interest in smoke abatement. More recently, I have communicated my ideas to an architect, Mr. George Herbert Kitchin, of Winchester, of whose taste and skill I have had experience, asking him to do what was possible towards producing an attractive design and to arrange for the manufacture of grates in accordance with his design.

The illustrations I have to show are: (1) Of grates of this kind as they have been in use in my house for many years past; (2) of Mr. Kitchin's designs, embodying some recent improvements in construction as well as in appearance.

The second of the two, which has the disadvantage of departing still further from established forms, will utilise a still larger proportion of heat from the fuel consumed. The charge of fuel compared with that of the flat grate is nearly the same, namely, as 75·4 to 72, the front of the fire, with whose area radiation varies, is as 25 to 18, or one-third greater. The back of the grate is formed by an eight-inch pipe of iron, or perhaps better of fire-clay, admitting air below and discharging it into the room at the level of the top of the fire. Much heat is thus utilised which would otherwise pass up the chimney.

Which of the two designs is better looking, or whether either is sufficiently good looking, are questions on the answers to which their future usefulness, for which I hope, must largely depend.

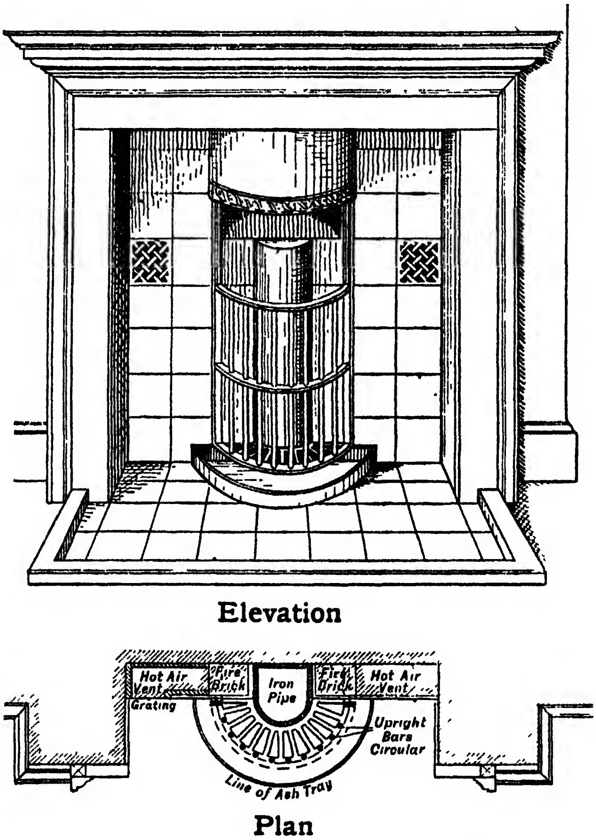

FIG. 7.—DESIGN FOR A SEMICIRCULAR GRATE IN WHICH HOT AIR FROM THE BACK OF THE FIRE PASSES INTO THE ROOM.

DISCUSSION.

THE CHAIRMAN (Mr. Francis William Goodenough), in opening the discussion, said the paper contained at the beginning a surprise which was not indicated by the title, and that was the way in which the author courageously exposed certain claims which had been made upon the public credulity in regard to the influence of a certain powder upon coal. The analysis of the powder which the author gave agreed very closely with a similar analysis of such a powder which had been published in one of the technical journals of the gas industry some short time ago. With regard to the benefit which would accrue to cities and towns by the abolition of smoke from domestic and factory chimneys, he (the Chairman) was an enthusiastic member of the Smoke Abatement Society, but he did not think he would be equal to explaining the magnitude of that benefit. As had already been pointed out, the result of the diminution of smoke from domestic and factory chimneys in London in recent years had been to increase the average hours of sunshine by something like eighty per annum; and when one remembered the vitalising effect of sunshine it was not easy to measure, but not possible to doubt, the advantage which would accrue to London from a further diminution, and finally a complete abolition, of the smoke nuisance. The comparisons which had been published by authorities like Dr. Saleeby between the lungs of the town dweller and the lungs of the country dweller were eloquent of the damaging effect of the smoke and gases given off by the crude fuel burnt in our grates and under our boilers. As the author had indicated, the solution of the smoke trouble was the use of coke and gas. In a recent paper read before the Society, Mr. H. M. Thornton had shown the extent to which coal gas had displaced the cruder form of fuel for industrial purposes, and everyone knew the rapidity with which gas had taken the place of coal in domestic use. The exhibition of the coke fire which the author had given that night, and his testimony as to its satisfactory use in his house for so many years, would, he (the Chairman) should think and hope, lead to a considerable increase in the use of coke for domestic purposes. In fact the ideal, evidently, was coke for constant use and gas for intermittent use; or gas for exclusive use where the labour-saving justified the extra expense, or where the user was willing to pay, as many users were, for the advantages to be obtained from what was the more expensive fuel for constant use if it was to be judged only by the cost hour by hour. He had in his hand the result of an investigation carried out by the Manchester Corporation on the question of gas and coal fires, which showed that although coal fires were cheaper in comparison with gas stoves in cases where rooms were used continuously and where burning went on all through the day, gas stoves were more economical, and—an important point—produced a more rapid rise of temperature, in cases where rooms were used intermittently. On those grounds, the use of gas stoves was desirable in committee rooms, which were used only occasionally or intermittently during the day. There were also in their favour greater cleanliness and a saving in labour attendant on their use. Accordingly the Manchester Corporation had decided to substitute gas fires for coal fires in the town hall in order to give a lead to smoke abatement in the city. In considering the question of the use of gas as against either coal or coke in the home, it was necessary to regard the domestic budget as a whole and not merely one fuel bill against another. That was an important point to be borne in mind.

MR. L. B. ATKINSON thought all must be gratified to feel that the author had disposed quite scientifically of the extravagant claims which had been made by the manufacturers of certain powders, supported by many great names of England, so far as families went. It only showed how little science such people adopted in their methods of conducting their own affairs, and perhaps some public affairs. The author had shown also some very interesting examples of how coke might be successfully burnt in a fire. The fact was, however, that although the discussion of fireplaces and fire grates had been going on for a very long period, it was extraordinary how the root of the whole matter was not reached. The fact was it had not yet been settled what was to be done with the coal fire. There had been discussions going on for the past few years, in which heating, medical, and physiological experts had taken part, as to whether what was required was to heat the air of a room or to heat the objects in a room. He thought everybody knew that on the whole it was more comfortable to have bodies in a room, both animate and inanimate, warmer than the air, than to have the air warmer than those bodies. For instance, the ordinary method of heating a house by radiators and pipes warmed the air first, and that, by conduction, warmed the objects in the room. The other way of heating was that which the author had referred to, and what his instrument showed—that the radiation passed through the air, hardly heating it at all, and warmed the other objects in the room. There was probably some balance between the two systems which was the most convenient. In his own home he had a hot-water central heating apparatus, by which he kept the air heated to about 55 degrees, and then for comfort he used fireplaces which were only lighted in the afternoon or evening. He believed that that was probably as satisfactory a system as could be devised with regard to the ratio of how much the air should be heated and how much the radiant heat should be relied upon for comfort. That was a point of view which required very careful consideration, and in which different forms of grates varied enormously. There were grates which would heat the air by passages behind them, and so on, and there were

other grates which would heat by radiation with very little warming of the air. As far as he knew, the only tests which had been published of the real efficiency of a grate were those to be seen in the *Lancet*, of May 19th, 1906. By "real efficiency" he meant the proportion of thermal units produced from so many pounds of coal which finally got into the room. That was the real efficiency of a grate. The tests were carried out, under the auspices of the Smoke Abatement Society in 1905, at the new block of Government buildings at the corner of Whitehall and Great George Street. Before fitting grates into the place the authorities set aside twenty rooms and invited manufacturers to test their various grates. At the conclusion of the general experiment, some tests were made of the actual efficiencies of the fires from the point of view of how many of the thermal units in the coal burnt finally came into the room, and the result—which he thought had never been contested—showed that of the total heat of the coal burnt that which was lost in the flue gases varied between 8·7 and 14 per cent. That meant that the percentage of the total heat of coal burnt which was given to the walls of the room chiefly by radiation amounted to about 86 per cent. It was clear, therefore, if those figures were correct, that there were forms of grates burning coal which were almost unsurpassed among technical apparatus of a common kind in the efficiency with which they converted the heat of coal into the purpose for which they were required, namely, getting it into the room. He thought few people realised that coal grates had reached that stage of efficiency. Over and over again he had gone into the question of gas coke as against coal, and he thought the gas companies did not sufficiently realise the damage they were doing themselves by not drying coke before they sold it. They often delivered large quantities of coke charged with water, and unless one had some means of pre-drying it the final result was not anything like equal to what ought to be obtained from the weight of carbon in the fuel.

Professor Wyndham R. Dunstan, C.M.G., F.R.S., thought the Society was indebted in more ways than one to the author for his paper. In the first place, the author had had the courage to do what a great many had not liked to carry out, namely, expose one of those very ingenious frauds which, from time to time, were perpetrated upon an uneducated public. He used the word "uneducated" advisedly, because in his view no one was properly educated who had not learnt something of the art of scientific observation. It was a matter of education, and such things were not likely to be altered unless we changed our system of education. He had been extremely interested in the ingenious instrument which the author called the "radio-thermometer," which might perhaps aid in solving some of the problems suggested by the last speaker. It was true that in warming a room by a fire, regard had to be paid to the radiant heat and also to the heat which was conveyed through the air, and he thought the author had devised a piece of apparatus which would enable a distinction to be made between those two forms of heat, and possibly would enable an estimate to be taken of the relation between the two. It appeared to him (the speaker) that the real solution of the smoke question was the use of gas. He believed in the end people would be converted to the use of gas fires, especially those worked upon the so-called incandescent principle. There was one point which he desired to commend to the notice of the Chairman and other representatives of the gas industry, and that was the price of gas, which appeared to him really to govern the whole situation. If cheap gas could be obtained smokeless fires would result, but so long as the price of gas was as high as it was, it was a bar to the extensive use of gas fires.

Dr. T. M. Legge said there were two points which had struck him in the paper: one, as to the success a fireplace would have in attracting the public taste or not. The suggestion he would make was that the author should enlist the interest and artistic ability of tile-makers. It was the tiles round the fire which made it beautiful, and not the fire itself; and so long as there were highly-glazed, smooth, and polished tiles there would be no beauty in the grate. The tiles must have rough surfaces and break up the light, not reflect it. The other point was the appalling price one had to pay for gas fires.

Mr. John Slater, F.R.I.B.A., said in his opinion the great efficiency of modern grates had been brought about by diminishing the depth of them. The old grates used to have a considerable depth from the front of the bars to the back of the grate, which did not occur in the new types. With regard to the cost of gas fires, recently he installed in his flat a number of gas stoves and a water heater. He had been told by the gas company that the water heater, if furnished with a thermostat, would enable him to get hot water all day long at a very small expenditure of gas. At the end of the first quarter he found he had used, on one of the floors only, 84,000 cubic ft. of gas. That was for the water-heater, a couple of bedroom stoves, and a small gas stove used for making toast. The gas company thought it rather excessive, and made a test, and it was found out he was using 860 cubic ft. of gas per day. The result was that he told the company to take their installation out and put something else in its place or he would go back to ordinary stoves. He happened to have a small cottage in the country, and the local gas company supplied him with gas for heating purposes at a very much lower rate than gas for lighting purposes. Could not the town gas companies instal a separate meter for heating purposes

in the same way? He thought if they could, many people would instal more gas stoves into their houses than they at present had.

Lieutenant-Colonel Allan Cunningham inquired what became of the ash in the author's type of grate. Surely there was a great accumulation of ash?

Mr. T. Potterton gave detailed figures in regard to a test which he had carried out in his house to ascertain the running cost of heating by coke, which showed that such cost amounted to a little over a farthing per hour.

Mr. H. Hartley said there was one point with regard to the author's type of grate which he should like to raise, and that was with reference to the ventilation. Unfortunately, one was dependent upon the entrance which was provided to the fireplace and the entrance to the chimney for ventilation of the room, and, if he understood the author, the suggestion was that the whole of such space should be filled up with coke, which would not entirely stop the passage of air up the chimney but which would probably interfere materially with the amount of air which passed through the room and up the chimney. Had the author conducted any tests to determine the effect on the ventilation of the adoption of the type of coke fire suggested in the paper? Mr. Harcourt would be interested to learn that an account of a radiometer, which the radio-thermometer resembled in some respects, had recently been published in the *Journal of Gas Lighting*. This instrument had been designed for use in connection with the testing of gas fires, and consisted of a block of metal, such as copper, which was suspended in an enclosure maintained at a steady temperature by a stream of water. This instrument enabled a high degree of accuracy to be obtained in the estimations of the radiant heat of gas fires.

Mr. A. H. Barker said Mr. Atkinson had quoted certain tests made ten years ago in regard to the efficiency of an open fire, and had stated that those tests had not been challenged. He (the speaker) thought a sufficient challenge of the accuracy of them was the careful study of them. He had read the tests when first published, and had then thought he had never seen such an absurd exhibition of incompetence as was displayed by them. The figure of 86 per cent. might be taken as worthless. No such efficiency had ever been obtained out of a coal fire. The tests had been carried out in the following manner. A certain weight of coal was weighed into a certain grate, and the combustion started, and measurements taken of the velocity of the gases up the chimney by some such absurd method as the exploding of some powder. The velocity was something like 3 ft. 6 in. or 4 ft. in a chimney 50 ft. high with a temperature of 120. The efficiency was taken in the following manner: The experimenters said, "We can only find that 14 per cent. is lost in the air. The difference, which we will not observe at all, and which is 86 per cent., must be transmitted into the room by radiation and so forth, and therefore the efficiency of the fire is 86 per cent." That was to say, the crucial point of the whole experiment, the tail-end, which was not observed at all, was quoted as the amount of heat usefully employed. Any experiments made on those bases condemned themselves.

The Chairman said Mr. Atkinson had raised the point of gas companies drying coke before they supplied it. He was afraid, if Mr. Atkinson wanted his coke dried by the gas companies before delivery he must be prepared to pay a considerably bigger price, because the labour involved would be considerable. The percentage of water in coke was not by any means a heavy one; it was only the water which was required for quenching the coke as it came from the retorts. As to the price of gas for heating purposes, gas undertakings could not, in justice to their consumers of gas for light, charge a different price for gas used for heating, because there was no appreciable advantage to a gas undertaking in regard to whether the gas they supplied was used in the daytime or was used in the evening. In the case of an electrical undertaking, where the demand had to be manufactured as it occurred, there was a great deal of advantage in getting a day load to occupy the idle plant. In the case of a gas undertaking, which was able to manufacture twenty-four hours a day, putting gas into the gasholder during the time of lightest demand, and drawing upon the gasholders during the time of maximum demand, no appreciable advantage could accrue from a levelling down of the load factor. The only advantage would be the reduction in the capital cost for storage, which would not justify any differentiation of price. It should be borne in mind that the price of gas throughout the country had steadily diminished in recent years. Another factor which had cheapened the use of gas for heating was the far greater efficiency of the modern gas fires as compared with the gas fire of a few years ago, in that very much more heat, especially radiant heat, was obtained for the gas consumed than was the case five or ten years ago.

The Author, in reply, said he was glad to hear that one need not accept as very authoritative the figures which had been given on the proportion of radiant heat to total heat which was produced by fuel. He thought the figures had been quite incredible. With regard to the question of ash, the ash settled itself. He had no doubt it did retard the rate of combustion, and in that respect there was powder which was naturally produced, and which had the effect for which another powder had been credited! As to water in coke, he had never suffered from coke retaining an undue quantity

of water. Some coke was exceedingly greedy of water. If coke was put in soak through the night it was surprising how good its appetite for water was. From that fact he gathered there was not much water in the coke when it was delivered.

A vote of thanks was accorded to the author for his interesting and valuable paper.

UTILISING COTTON STALKS.

At Greenwood, Miss. (U.S.A.), a pulp mill with a capacity of 50 tons daily is being erected to manufacture pulp for paper-making from cotton stalks, a hitherto unused by-product of the cotton fields.

This industry is of vast economic value to the cotton-growing sections of America, as well as of great value to the paper-making trades at this time of increasing scarcity in pulp-making materials the world over.

The cotton plant is a well-known annual plant, the stalks of which, after producing its crop of cotton, have been destroyed by the farmer in preparing his ground for the succeeding crop. A conservative estimate of the annual supply of cotton stalks in the cotton-growing sections of the United States is about 75,000,000 tons. If but 25 per cent. of this can be utilised it will aggregate an approximate production of 6,000,000 tons of paper annually, worth more than £10 per ton. As there appears to be an inexhaustible supply of cotton stalks that are useless for any other purpose, it ensures a "raw material cost" of little variation from year to year. Usually about 10,000 cotton plants are grown on an acre of ground. In the Yazoo Delta section the growth of the cotton plant is large, often attaining a height of 8 ft., 10 ft. and 12 ft., the stalks of which in a dry condition weigh from ¾ lb. to 3 lb. each.

The best cellulose for durable papers will be obtained from the fibres of the cotton plant. This particular fibre is a thin-walled tube which collapses in a peculiar twisted manner in the beating process, interlaces in the felting process much better than any other fibre and holds its grasp tenaciously. It is strong, flexible and durable, of light weight, and with double the tensile strength of stock used in ordinary wrapping paper.

Paper made from cotton-plant fibre, when nitrated, becomes an efficient and convenient form of smokeless powder.

Chemical works will also be erected at Greenwood in which to conserve and refine the by-products produced which will be of much value in arts and manufactures.

Large quantities of old cotton stalks are being delivered at the mill site, the cost delivered being about 12*s*. 6*d*., or $3 U.S. currency, per ton. The daily consumption of stalks will be 150 short tons, which will produce 50 tons of valuable pulp.

The mill located on the Southern Railway at Greenwood, Miss., is the first commercial pulp-mill of its kind ever erected, and the industry has promises of surpassing the present importance of the cotton oil industry in America.

The process and details for manufacturing pulp and paper from cotton stalks were worked out and the value of the product demonstrated in an experimental plant at Philadelphia, Penn., with the result that it was decided to construct a commercial and permanent plant at Greenwood, Miss., U.S.A.

WILLIAM C. OLDS.

INDIAN RAILWAY EARNINGS.

Up to the week ending February 6th the total decrease of railway earnings as compared with the previous year was 2·94 crores of rupees, or a decrease of 5½ per cent. A detailed statement in the *Gazette of India* gives figures for each railway, which are of considerable interest.

Six railways show decreases of over 10 lakhs of rupees, the list being headed by the G. I. P., which shows a loss of 75 lakhs, largely owing to the cessation of cotton exports and the general disappearance of the export and import trade of Bombay during the early months of the war. Next comes the Eastern Bengal State Railway, with a loss of 46 lakhs, due to the decrease of jute exports. The third is the North-Western Railway, with a loss of 37 lakhs, due to the shortage of wheat exports and war disorganisation. The Oudh and Rohilkand Railway, for similar reasons, is fourth on the list, with a decrease of 31 lakhs, while the B. B. and C. I. (standard gauge) is fifth, with a decrease of 17 lakhs, and the Bengal-Nagpur Railway is sixth, with a decrease of 12 lakhs.

Six railways show decreases between 5 lakhs and 10 lakhs—namely, the East Indian Railway (9½ lakhs), the B. B. and C. I. metre gauge (8¾ lakhs), the Burma Railways (6⅝ lakhs), the Jodhpur-Bikaner (6⅜ lakhs), H.H. the Nizam's (6¼ lakhs), and the South Indian (6 lakhs).

Fifteen railways show losses between 1 lakh and 5 lakhs.

Among the lines showing increases several are those which have only recently been opened. The largest increase is from the Delhi-Agra Chord of the G. I. P., which shows an increase of 75,000 rupees. Four lines show just over 1 lakh increase each.

The list of the gross losses, however, is not a good guide to the severity with which the decreases are felt by individual railways. A loss of 9½ lakhs on 9 crores earnings, as in the case of the East Indian Railway, is not felt so much as a loss of 4 lakhs on 14 lakhs earnings as in the Bhopal-Itarsi line. To gauge the position, therefore, from the railway point of view, it is necessary to group the lines according to percentage losses of gross

earnings in 1914. Arranged thus, the principal railways show the following results :—

Decreases (percentage)—Bhopal-Itarsi (G. I. P.), 27; Burma Extensions, 22; Oudh and Rohilkhand, 15; Eastern Bengal State Railway, 14⅜; Jodhpur-Bikaner, 14; Nizam's, 12; G. I. P. (main line), 10⅝; B. B. and C. I. (standard gauge), 5½; North-Western Railway, 5; Tirhoot, 5; Darjeeling-Himalayan, 4½; Burma, nearly 4; Bengal-Nagpur Railway, 3½; South Indian, 2½; Assam-Bengal, 2; Madras and Southern Mahratta, 1·2; and East Indian Railway, 1.

Increases (percentage) — Jullundur - Doab, 66; Agra-Delhi Chord (G. I. P.), 3; and the Delhi Umballa-Kalka, 2½.

Put this way, it will be seen that the G. I. P. falls from the first to the seventh place, while the East Indian Railway drops from the seventh to the seventeenth, its 9½ lakhs representing only 1 per cent. on the gross earnings.

So far as the revenues of India are concerned, however, it is the gross totals that matter. They show a loss up to February 6th of 264,00,000 rupees on State and guaranteed lines, and 29½ lakhs on all other lines.

AGRICULTURAL CO-OPERATION IN SOUTH AUSTRALIA.

In the early days of Australian colonisation, when the settlers, measuring the new country by English standards, took up individual holdings of some 80 acres in extent, a primitive form of co-operation may be said to have existed. Few of the farmers possessed all the implements necessary for working a farm successfully: each borrowed from his neighbours what he lacked himself; so that, in a sense, the first settlers were co-operators.

But that stage of cultivation has passed away. Farms at the present day consist of any number of acres from 1,000 to 5,000, and are stocked with the most modern machinery and other aids to cultivation, so that each forms an independent producing unit. Co-operation among farmers under these conditions must naturally be something quite different from the primitive co-operation of the pioneer settlers; and in fact such agricultural co-operation as now exists in Australia is chiefly represented by a few large societies for purchase and sale which number their members by thousands, own a large amount of valuable property in the form of warehouses, machinery and farm supplies, and transact business upon a huge scale.

The work of the two principal agricultural co-operative societies in South Australia is dealt with in an article in the January number of the *Monthly Bulletin of Economic and Social Intelligence*, published by the International Institute of Agriculture. The two societies are the South Australian Farmers' Co-operative Union and the Eudunda Farmers' Co-operative Union, and the article in question is contributed by Mr. T. E. Yelland, Secretary of the South Australian Union.

The South Australian Union, founded twenty-five years ago, has now some 6,000 members, owns offices and machinery stores in Adelaide and warehouses for wheat, skins and wool in various parts of the State, conducts a large banking business, and even publishes a monthly newspaper for the information of its members. The society sells wheat, oats, barley, hay, wool, skin, hides and livestock on behalf of its members, and supplies them with corn-sacks, hardware, manures, farm implements and machinery, including engines. Though registered as a limited company, the society is conducted strictly upon co-operative lines, all profits, after providing adequately for a reserve fund, being distributed among the members, and membership being open to all farmers without exception. About 70,000 shares have been allotted. The minimum number that may be held is ten, and the maximum actually held by any one member at present is about two hundred and fifty. The voting power is so distributed that any two members holding twenty shares each can outvote the largest holder of shares in the society. Shares are transferable under certain conditions.

The management of the society is vested in seven directors elected by the shareholders, and the business is divided into departments with a manager in charge of each.

The other society described by Mr. Yelland was founded at Eudunda in South Australia about eighteen years ago. A number of the farmers of Eudunda who sold the wood from their property as fuel, dissatisfied with the prices obtained in the towns, appointed their own agent in the city market. The agent was charged with the sale of the wood and the purchase of household supplies for the farmers. This arrangement proved very satisfactory, and little by little the transactions of the society were extended to other farm products. The society opened stores at convenient points on the railway. At the present time there are fifteen of these stores, and the company has placed a trading steamer on the River Murray and is thus able to cover a very large district. There are more than 2,500 members; the share capital amounts to £31,000; and the reserve fund to £3,360. As a rule the society pays a bonus of 5 per cent. on purchases and the same rate on capital.

Co-operation has also been applied to two other branches of agriculture in South Australia, namely, dairy farming and fruit-growing. A number of co-operative butter and cheese factories have been established by dairy-farmers in the south-eastern part of the State about three hundred miles from Adelaide in a good grazing district, and the results obtained have been very satisfactory. Nearer to Adelaide co-operative dairies have been started, but have not proved a success, and the producers who formerly supplied the milk to the co-operative concerns now separate the cream with a hand "separator" and send it to private butter factories in the towns.

Co-operation among fruit-growers is of recent

introduction, but gives promise of being very successful.

Naturally co-operators in Australia are beginning to feel the need of a central federation of co-operative societies. The co-operative spirit is growing; the farmers as a body are becoming interested in the movement; and it will probably not be long before the existing societies combine for the development of their business and the protection of their common interests.

ARTS AND CRAFTS.

Nature Study and Art.—The spring show at the Whitechapel Art Gallery is generally of interest to lovers of arts and crafts, and this year the committee had the happy inspiration of holding an exhibition of nature study and art The exhibits were distributed over four sections, the second of which was devoted to design and craftwork, and was planned to show "the different treatment necessary when . . . natural forms are used for decorative purposes." To say that the collection might with advantage have been enlarged in some directions and curtailed in others is, perhaps, only to admit that it shares the characteristics of all exhibitions. Certainly the promoters of this particular one set themselves a very difficult task, and one very well worth the doing. If only an exhibition of the same kind could be organised on a larger scale and in a more central position, with expert demonstrators in attendance to show students why some treatments of natural form are good and some bad, and why certain conventions obtain in designs for particular processes it might do much to awaken in the rising generation that sense of design for which the desire to capture German trade ought to provide a demand. With a competent guide to point out the knowledge and dexterity demanded by such apparently simple work, Mr. C. F. A. Voysey's designs for textiles, embroidery and wallpapers might prove very stimulating; at Whitechapel one could not but feel that they would probably lead unwary students astray. That kind of work looks, and is, so simple when you are an accomplished draughtsman, but the beginner would be well advised to leave it alone. Mr. Walter Crane's wallpaper designs, on the other hand, give no illusion of simplicity. It quite evidently took a master to design them, but they are beautiful examples of elaborate pattern design. Perhaps the most practically useful exhibits were those sent by Mr. Christopher Whall, including studies of swallows and plants, together with the use to which they have been put in decorating a roof, and also drawings of foliage and the decorative rendering of them in cartoons for stained glass. It is just at this point that so many would-be designers fail. They can make a study, but when it is made they often do not know how to use it; or they can scheme the lines of a design and fall short when it comes to clothing the skeleton with foliage which is at once conventional and not unnatural. Mr. Lindsey P. Butterfield's copies of old ornamental floral and foliated forms were of a kind admirably suited to guide the student aright, and to remind him of the necessity for studying not only nature herself but also other people's interpretations of her. One would have liked, however, to see a larger series of plant sketches more or less on the lines of the few excellent examples by Miss J. Foord to show how plant-form studies should be made with a view to their use as bases for designs. Many learners and teachers, too, fail to realise that to make a drawing of a plant is not necessarily to provide oneself with useful material for a repeating pattern or even for a design to fill a space. A useful object-lesson in the difference of effect between a design for chintz and the same pattern printed on the actual fabric was furnished by the series of Morris designs accompanied by the reproductions from them, but it is to be regretted that the authorities did not always find it possible to hang the original and the copy side by side with the pattern running in the same direction.

The committee of the Whitechapel Art Gallery have achieved a very useful piece of work in initiating an exhibition of this kind, but there is room for more to be done in the same direction. The improvement of our design is a much more important matter than many people will allow, and one which is of the greatest moment to some of our large manufacturing interests. British craftsmen at last seem to have awakened to this fact. It is to be hoped that they will set to work in practical fashion not only to draw artists and manufacturers together, but to improve the training of the designer.

Jewellery.—It is now many years since the making, by men and women craftworkers, of a different kind of jewellery from that ordinarily shown in the shops came into vogue. The English movement was itself an outcome of the popularisation in this country of French work of more or less the same type; but whilst the French artistic jewellery was as a rule the output of craftsmen trained in the workshop who happened to have, over and above their manual dexterity, real artistic taste, the earlier British work, on the other hand, was produced by men, artists by training, who later on in their career turned their attention to craftwork. The result was that a good deal of the handmade jewellery of this period, though admirable in conception, was somewhat lacking in technical accomplishment. Jewellery making became after a time a popular craft, one might almost say a fashionable hobby, for the amateur, and art students—especially women art students—took it up in

the hope of making money by it when they were but poorly equipped for their task. Indeed, from the point of view of the man in the street, little versed in matters artistic, the momentary flutter might almost be said to have died out, leaving behind it as its contribution to the arts and crafts movement of the day a type of machine-made jewellery sold in a few shops planned rather on the lines of the handmade articles, and a small demand for inexpensive craft jewellery met mostly by women craftworkers turning out their wares at a price which does not suggest that jewellery making is a craft at which a living wage can be earned. That is not, however, the whole of the story by a very long way. The fashion has indeed passed, but it has left behind it a good deal more than that. It has influenced considerably the style of the less expensive jewellery commonly worn, so that the characteristic ornaments of many lands find a readier market over here than they used to do. Not only Swiss and Italian work is to be seen in the London shops to-day, but Russian peasant work and Scandinavian filagree and enamel, as well as Indian, Japanese, and Chinese jewellery. Further, though its influence on British trade-work has not, on the whole, been very great, we have to-day a body of craftworkers (women for the most part) who are doing thoroughly good work of a very modest type, and a few whose productions are worthy to be compared with the best examples of old work and of modern foreign workmanship. Of recent jewellery of the simpler kind, the specimens shown at the little exhibition of the '91 Art Club, held at the Alpine Club, were very good examples. Several lady jewellers exhibited their handiwork, all of which reached a satisfactory standard of design and workmanship. The case of objects shown by Miss Ethel Rickert contained some pretty little brooches and pendants, whilst the exhibits of the Misses Frances and Violet Ramsay had a distinctive character of their own which marked them out from the ordinary work of the kind. Their pendant of gold and silver set with lapis-lazuli and blister pearls, unusual and rather oriental in form, was a particularly well-thought-out piece of work. Amongst jewellery of a more ambitious kind, the necklace in gold and precious stones and the Golden Fleece pendant designed by Mr. Edward Spencer for the Artificers' Guild, and carried out by Messrs. W. Glennie and Charles Moxey, is deserving of notice. The galley, her sails well filled with wind, rides gallantly on a sea of blue opals studded with rocks of uncut sapphire. The treatment of the boat and its surroundings is highly decorative, and the workmanship is worthy of the design. The arts and crafts movement may not have done for jewellery all that it was hoped it might accomplish, but it has given rise to a type of work, by no means to be despised, which has certainly come to stay.

Spring Colour-schemes.—Colour schemes this spring are still on the sombre side. The daring hues of the Austrian prints exhibited at Goldsmiths' Hall find very little echo in the London shops. There are a few gorgeously-coloured French dress silks about, and some brilliant Chinese embroideries, but the British furnishing fabrics are no more cheerful in colour than they were last autumn. This may be partly due to difficulties in obtaining dyestuffs, but a certain quantity of these is coming in from Switzerland, and it looks rather as though people had become so accustomed to khaki that pure bright tints do not for the moment attract them. What little vivid colour there is about is practically confined to cretonnes, and is almost always on a black ground, so that, brilliant as some of it is in itself, the effect of the material as a whole is not really gay. For the most part, the colours on the black backgrounds are deep rich purples and greens, which even on a white ground would look rather sober. The prevalence of shadow-printed materials, further, makes for a lowness of key in cretonnes and linens of a rather different kind. Carpets reflect the prevailing taste of the moment, the plain ones are often black or buff, and those which are patterned are, very often rather subdued in tone. Tapestries and damasks, again, are mainly on the dull side.

CORRESPONDENCE.

MOTION OF LIQUIDS.

Whilst thanking Professor F. C. Lea for his review of my little book on "Motion of Liquids," there are one or two small misconceptions in it which I should like to remove.

He says I make "an attempt to show that when a body is at rest in a flowing stream, the pressures behind are not the same as when the same body is moving at the same velocity in a liquid at rest"; it should be "in front of," and not "behind." This is, of course, what is called in France *le paradoxe de Dubuat.*

Again, it is hardly fair on me to say that I separate "impact with shock" from "static liquid." Remembering Sir W. Herschel's caution* that "some, nay most, [words] have two or three meanings; sufficiently distinct from each other to make a proposition true in one sense and false in another. . . . It is, in fact, in this double or incomplete sense of words that we must look for the origin of a very large portion of the errors into which we fall"—remembering this, I found authors ordinarily employing the word "impact" in a very loose manner, and to avoid doing the same myself, I used the word in two senses, which I defined as "impact with shock" and "impact without shock." Similarly I differentiated between "static liquids" and "non-static liquids." This

* Discourse on "The Study of Natural Philosophy."

is, in fact, the leading idea, or dominant note, of the whole book.

Since the meaning of "static" is not generally understood, I will give an example in explanation. The water in the Marylebone swimming-bath is a "static liquid." It cannot be said to be "at rest," since we know that it is moving at a velocity of 50,000 or 60,000 miles per hour. It is, however, not changing its shape—there is no relative motion between any of its parts—it is moving like a solid.

A few miles away is the River Thames, the water of which is moving a very few miles faster or slower than the water in the bath; the difference would be only measured by some hnudredths of one per cent. It is a "non-static liquid," for the different parts are constantly changing their relative positions. Propositions which are true for the water in the bath are not necessarily true for the water in the Thames.

Certainly I follow the teaching of "Newton, Dubuat and others"; the expression "and others" is, however, hardly an appropriate one to apply to such names as Sir George Stokes and Lord Kelvin. I should prefer to say that I follow the teaching of "Lord Kelvin and others." A very cursory study of Thomson and Tait will show that Lord Kelvin believed in the parabolic formula expressing resistance and not in the logarithmic one.

The small sting in the review (if there is one) is to be found in the tail, where I am accused of neglecting "the enormous mass of data gathered during recent years."

It is quite true that I must plead ignorance of Mr. Lees' work on the flow of liquids in pipes, but, *per contra*, I refer to even later work on this subject by an author who will, probably, carry more weight than even Mr. Lees—Dr. Stanton, of the National Physical Laboratory. He has shown, experimentally, that the resistance may be expressed as

$$R = A\mu\,(Vl) + \rho B\,(Vl)^2,$$

where the power of V involved in the first term is certainly unity.

I regret not being aware of the "enormous mass of data gathered during recent years" on the resistance of liquids, though I know of a good deal on air resistance. Finzi and Soldati have done some work on water; Riabouchinsky has started a hydrodynamical laboratory, but has published nothing yet. I know of no systematic work later than Bazin.

R. de Villamil.

THE UTILISATION OF SOLAR ENERGY.

As your reporter did not catch the name of the inventor of the steam-ether compound-engine, perhaps you will allow me to state again that he (du Trembly) and Dr. Latiere, of La Seyne, concluded rightly or wrongly that it was more economical to use the sun for growing fuel than for raising steam; and this was so firmly impressed upon my youthful mind in 1856 (five years before Mouchot's patent) that it sticks there still! To compare efficiencies *per acre* is misleading; for, where land is available and labour cheap, it is possible to burn, in boilers occupying less than one-tenth of an acre, the fuel gathered over a thousand acres, and thus to save the enormous expense of a few acres of reflectors.

Monsieur C. Tellier made a name and some money for himself in connection with the "Frigorifique," as he was the first man to bring chilled meat from South America; and, in 1879, one of his refrigerators was taken out of the "Frigorifique" by me and set up experimentally for Mr. D. Tallerman in the arches under Cannon Street Station; but, some ten years later, I found that Tellier was beginning to dabble in solar-energy schemes—and he has since died a pauper!

When we have used up all our coal and oil, all our timber and other vegetation, we can turn our attention to improving the type of apparatus about which Mr. Ackermann has given us such a valuable paper. It is possible to increase the efficiency of the Shuman plant by first raising the temperature of the water considerably without using reflectors, reserving the latter only for turning hot water into steam; but, even so, the solar-energy machine cannot compete economically against other means at present in vogue.

W. H. Massey.

9, Queen Anne's Gate,
Westminster, S.W.

At the meeting last night, when Mr. Ackermann read a paper on "The Utilisation of Solar Energy," I was reminded, by the mention of Mr. W. Adams, that in 1877 or 1878 I was, in a small way, a collaborator with that gentleman in some of his experiments. He came over to Calcutta to see if his work could be brought into more extensive practical use, and called upon me with a Colonel Money, who was largely interested in tea-growing and preparation, to discuss the question of the application of direct solar heat to the several processes of tea preparation, raising steam, drying tea, etc. I recommended that a practical experiment should be made at once to test the capability of his plan to get up and maintain steam in a small boiler. I selected one of 6 h.p. capacity, made of thin steel sheets, suited to external firing, and placed it in the focus of a large curved reflector composed of ordinary silvered glass panes 9 ins. by 6 ins., in portable wooden frames. I do not remember the dimensions of the reflector or the focal length, but they were fixed at what Mr. Adams considered, from his experience, to be sufficient for, and best suited to, the purpose.

The sun's rays were impinged by reflection on a suitable area of the boiler shell for the whole of a bright day in February, but the heat rendered available was not sufficient to raise the water in the boiler to 212° F. Two or three trials were made, with such alterations as suggested themselves, but without any success, and the experiments were given up.

I did not make these remarks in the discussion as there were many speakers, but it occurs to me that they may be of some interest.

South Villa, The Vale, Hampstead, N.W. G. E. JONES.

With regard to Mr. A. S. E. Ackermann's very interesting paper on Solar Energy, which he read before the Society last week, I wish to say that, appreciating the fact that the present installations are evidently only in their infancy, I cannot help thinking that some form of sun-power energy must have been employed in the time of the Pharaohs. Those vast Pyramids, and the Sphinx itself, must, to my mind, have been hoisted by more than actual manual labour. I think, therefore, that there is a great future for sun-power plants when more fully developed.

D. R. BROADBENT.

18, Victoria Square, S.W.

NOTES ON BOOKS.

A HISTORY OF THE ROYAL DUBLIN SOCIETY. By Henry F. Berry. London: Longmans, Green & Co. 1915.

The "History of the Royal Society of Arts," published two years ago, has now been followed by a companion volume recording the history of the sister, and rather older, institution of Ireland. The publishers have paid us the compliment of closely imitating our *format*, for the two volumes, in size, printing, binding and general appearance, are so similar that they might be taken for two volumes of the same work. And as the two books resemble one another externally, so also their internal contents deal with objects almost identical.

It may be hoped that our own history helped to provide some information about the arts and industries of England during the latter half of the eighteenth century and the first half of the nineteenth, and it is pleasant to be able to testify that the kindred volume is full of most valuable information about Irish progress in science and art during the same, or indeed during a rather longer period. Personal considerations, which necessitated the curtailment of the English record, have fortunately been absent in the case of the Irish one. Dr. Berry, whose well-known familiarity with Irish historical questions renders him admirably qualified for his task, is not, so far as the present writer is aware, officially connected with the Royal Dublin Society, so that there can have existed no feeling of responsibility for the work of recent years to prevent his carrying on his record to the present date.

Amongst the very earliest records of the Society of Arts there is still preserved a MS. account of the origin and progress of the Dublin Society, "for the encouragement of Husbandry and kindred objects," which was read, at a meeting held on June 16th, 1756, by Philip Carteret Webb, the well-known antiquary and lawyer, who took a leading part in the prosecution of John Wilkes seven years afterwards. The communication was sent by Mr. William Henry, of Kildare Street, to Dr. Stephen Hales, for the Society.

There need be no reason to doubt that the organisers of the London Society profited by the experience of those who were carrying out precisely similar work on the other side of St. George's Channel. It is certain that the two Societies were in frequent communication, and worked harmoniously together. The lists of "premiums" offered were exchanged and ideas or suggestions were reciprocally adopted. A pleasant proof of the friendly relations existing is afforded by the fact that the President and Secretary of the Society of Arts (for the time being) have for long been honorary members of the Royal Dublin Society.

One great difference there is between the two Institutions. The Irish one from a very early date has been liberally subsidised by the State. The English one has never received a penny of Government money. On two occasions, in connection with the formation of the 1851 Exhibition and with the foundation of the South Kensington Museum, it was repaid a portion of the funds it had expended, but on those occasions it was exceptionally fortunate. The treatment of the Irish Society was very different. In 1746, when the Society was not yet fifteen years old, the Earl of Chesterfield, when Lord-Lieutenant of Ireland, recommended that a grant should be made to them of £500 a year, and this was at once done. Some other gifts of public money are referred to, and in 1761 it commenced to receive regular Parliamentary grants (from the Irish Parliament). In that year a sum of £12,000 was voted to it. The precise amount allotted appears to have varied from year to year, but "in the year 1800, the last of the Irish Parliament, the Society's grant amounted to £15,000." After the Union £10,000 for twenty years was granted. This was afterwards reduced to £7,000, and (in 1831) to £5,500. This considerable income, supplemented by the contributions of members of the Society, was for the most part expended precisely in the same way as the funds of the London Society of Arts, in premiums for the encouragement of Agriculture, Industry and Fine Arts, and there can be on doubt at all that in both cases the money was usefully and beneficially employed.

That in the early days the administration was a little lavish is the only piece of criticism which may fairly be offered. For this an ample excuse is provided by the ready supply of Government money placed at the disposal of the administration. Our own predecessors deserve no credit for the fact that a strict economy was forced

upon them by the need for collecting their revenues from the public before they spent them.

When the time came for the abandonment of the eighteenth-century notion of encouraging industrial development by small prizes; when it was found that industrial development itself provided rewards far larger than could be supplied by societies and committees, however benevolent and well-intentioned, the Dublin Society was fortunate in possessing the funds and the State support which enabled it to devote its energies to purposes better suited for modern needs.

It must certainly be the fact that no other Institution in the three kingdoms has received anything like the same amount of State assistance, and it is also a fact that the Society has made excellent use of the funds with which it has been provided.

Its constitution has been on several occasions very considerably modified. Its first charter was obtained in 1750, and its principal objects then were the encouragement of Husbandry, Manufactures and Art. In 1866 it obtained a supplemental charter, and in 1888 a second supplemental charter. On both occasions great alterations were made in its constitution to correspond with the changes which the course of time had necessitated in its objects.

Its Drawing School, started in 1751, rendered valuable service by educating Irish artists until it was transferred to the Science and Art Department in 1878. Its Agricultural Research Laboratory and its Geological Museum, both established at the very beginning of the nineteenth century, each in its own province did invaluable work until they also were taken over by the Science and Art Department in the year above mentioned. Its Botanic Garden, founded in 1737, and in later years largely subsidised by the Government, deservedly attained a very wide reputation until its control also was taken over by the Department in 1878.

Its Library, which dates back to 1731, was in 1877 converted into the National Library of Ireland, under the Science and Art Department. The National Library still occupies a part of Leinster House, where the Society established itself in 1815.

About 1800 it dropped its agricultural work on the foundation of the Royal Agricultural Society of Ireland. But when that Society came to an end in 1830 the Royal Dublin Society renewed its agricultural labours, though they took a new form, and led to the establishment of the two celebrated shows of live-stock and of horses, which probably are the most popular undertakings the Society ever undertook—indeed, its Horse Show is probably more widely known than any of the Society's more strictly scientific work.

It also had its part in the origination of International Exhibitions, and the exhibitions of Manufactures started in 1835 culminated in the fine Industrial Exhibition of 1853.

Of late years, since its last Charter of 1888, the Society has confined itself more strictly to pure science work on the same lines as the Royal Society of London, and to the promotion of Agriculture, principally by the two shows above referred to.

The long history, which is given in full detail by Dr. Berry, should be studied with interest by the Fellows of the kindred Society, which during practically the same period of time has been carrying on work, often identical, and always closely allied, with that of the chief scientific institution of the sister kingdom. Both Societies alike, the Irish and the English, can look back on a long history of valuable work efficiently carried out; both alike have had their successes and their failures. But, on the whole, no fair-minded student of the history of both Institutions can fail to recognise the value of the labours of both of them. In both cases alike, their objects and their efforts have changed with the changing years, and both alike may confidently still look forward to a prosperous career, if in the future, as in the past, they show themselves capable of adaptation to the constantly altering conditions of Science, Art and Industry.

WOOLLEN AND WORSTED. By Roberts Beaumont, M.Sc., M.I.Mech.E. London: G. Bell & Sons, Ltd. 30*s*. net.

Professor Beaumont's "Wool Manufacture" has long been recognised as a standard text-book on the subject. When the third edition was exhausted, he was asked to prepare a thoroughly revised fourth issue. The result of this request is the present volume, which, however, must be regarded more as a new work than a mere revision. It deals with all the processes connected with the production of woollen, worsted, and union textiles, and complete new sections have been added on wool scouring and drying, carding, condensing, combing, drawing and spinning machinery and operations; the French system of worsted yarn construction; the principles of design applicable to the several grades and classes of woollen textures made of wool and other fibrous substances; and recent developments in the art of manufacturing.

A great deal of original research into the various qualities of wools and other fibres has been conducted by Professor Beaumont, and the results of this are embodied in the book. There are also full and valuable descriptions of the different types of mechanism, illustrated by sectional drawings.

A word of praise must be given to the publishers, Messrs. G. Bell & Sons, Ltd., who have produced the book in a manner entirely

worthy of a standard work. It is printed in large clear type, and contains 469 illustrations in the text in addition to 42 plates. The blocks are so excellent that they could hardly be improved.

GENERAL NOTES.

New Zealand Fisheries.—Mr. W. G. Wickham, H.M. Trade Commissioner for the Dominion of New Zealand, has been making a tour of the east coast of the Southern Island. The most important fishing centre in New Zealand is the Bluff, and he comments on the possibility of erecting fish-manure works here. Many farmers in Southland, he says, know the value of fish manure, and the local freezing works at Ocean Beach, which now treat meat offal, could also deal with fish. The fishing is of two kinds. There are the deep-sea oyster-beds round Stewart Island, from which supplies are drawn for New Zealand and for shipment to Tasmania and Melbourne; and the ordinary deep-sea trawling and netting. A few of the boats engaged in the latter branch are fitted with refrigerators, and are thus enabled to stay at sea for several weeks The fleet numbers at least one hundred craft, ranging from fairly large steam-trawlers down to large launches and sailing-boats. The launches and sailing-boats are all fitted with auxiliary oil engines.

Production of Potash from Kelp in the United States.—H.M. Consul-General in New York (Sir C. W. Bennett, C.I.E.) has forwarded an extract from the local press, in which it is stated that 10,000 tons of American potash manufactured from kelp were recently sold in New York at a price comparing favourably with that commanded by the German product in normal times. The source of this potash is what is known as "giant-bladder" kelp, which, when dried, contains over 20 per cent. of potash, as well as other substances valuable to fertiliser consumers. The kelp is gathered by a submarine harvester, with a cutting device mounted between two pontoons. This harvester cuts through the kelp groves a swathe about 16 ft. wide and from 2 to 10 ft. below the surface of the water; by cutting 5 ft. below the surface it is found that 85 per cent. of the total weight of kelp is harvested. The kelp, when cut, is automatically gathered from the water and chopped into 6 in. lengths. The harvester with scows attached has a capacity of 50 tons per hour, from which 5 tons of dried kelp are obtained.

Australian Molybdenum. — Molybdenum, which is practically indispensable for the production of certain grades of steel, has in the past been supplied to this country almost exclusively by Germany. The ores occur over a wide area in Australia, and also in Norway and Peru. Arrangements have recently been concluded, according to the *Times*, for the installation of a well-equipped plant in Australia to deal with the local ores, which for many years past have been carefully picked and sent to Europe for treatment. The ores, both of South Australia and Queensland, are chiefly ores of bismuth, which contain also wolfram and molybdenum in very small percentages, and the new plant will render it possible to use some of the poorer materials hitherto rejected. Certain of the richer ores of the molybdenum, found in Queensland, can be hand-picked so as to attain a value approaching £300 a ton for shipment to this country.

MEETINGS OF THE SOCIETY.

Ordinary Meeting.

Wednesday evening, at 8 o'clock.

May 12.—Charles R. Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry." Sir Robert Abbott Hadfield, D.Sc., F.R.S., will preside.

Indian Section.

Thursday afternoon, at 4.30 o'clock:—

May 13.—Sir Charles H. Armstrong, late Chairman, Bombay Chamber of Commerce, "Indian Trade and the War." The Most Hon. the Marquess of Crewe, K.G., P.C., Secretary of State for India, will preside.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

David Sommerville, B.A., M.Sc., M.D., M.R.C.P., D.P.H., Assistant Professor of Hygiene and Public Health, University of London, King's College, "Foodstuffs." Four Lectures.

April 26, May 3, 10, 17.

Syllabus.

Chemical Constitution of Foodstuffs—Proteins—Carbohydrates — Fats — Inorganic Substances — Colloids and Crystalloids—Metabolism—Enzymic Action in the Alimentary Canal.

MEETINGS FOR THE ENSUING WEEK.

Monday, May 10 ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Dr. D. Sommerville, "Foodstuffs." (Lecture III.)

Mechanical Engineers, Institution of, at the Institution of Civil Engineers, Great George-street, S.W., 8 p.m. (Graduates' Section.) Mr. T. E. Chrimes, "The Running-shed Maintenance of a Locomotive."

Engineers, Society of, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 7.30 p.m. Mr. A. H. Barker, "Some Future Developments in Heating and Ventilation."

Surveyors' Institution, 12, Great George-street, S.W., 8 p.m. Mr. W. Allen, "A Summary of the Session's Papers on the Acquisition of Land, Tenure, Rating, and Housing."

East India Association, Caxton Hall, Westminster, S.W., 4 p.m. Mr. V. A. Smith, "Akbar, the Great Mogul (1542-1605): His Life, Character, and Opinions."

TUESDAY, MAY 11...Faraday Society, at the Institution of Electrical Engineers, Victoria embankment, W.C., 8 p.m. 1. Professor A. W. Porter, "On Von Babo's Law and Kirchoff's Equation for the Latent Heat of Dilution." 2. Mr. D. O. Wood, "The Vapour Pressure of Concentrated Sugar Solutions." 3. Mr. F. H. Campbell, "The Vapour Pressures and Specific Volumes of Binary Mixtures of Volatile with Non-Volatile Liquids." 4. Mr. R. H. Callow, "Reaction Velocity in a Viscous (Heterogeneous) Medium." 5. Messrs. K. C. Browning and C. T. Symons, "Notes on a Convenient Thermostat for Accurate Specific Gravity Determinations and a Gas Pressure Regulator." 6. Mr. E. J. Hartung, "A New Method for Determining the Specific Heat of Liquids." 7. Dr. J. S. Anderson, "An Electromagnetic Vacuum Balance." 8 Dr. E. B. R. Prideaux, "Note on the Neutralisation Curve of Boric Acid." 9. Mr. N. M. Bell, "On the Anodic Solution of Lead." 10. Messrs F. J. Harlow and R. S. Willows, "A Simple Method of Deriving the Gibbs Adsorption Formula." 11. Mr. F. C. Thompson, "The Elastic Strength of Metals."

Royal Institution, Albemarle-street, W., 3 p.m. Professor C. S. Sherrington, "The Animal Spirits." (Lecture II.)

Photographic Society, 35, Russell-square, W.C., 8 p.m. Mr. F. F. Renwick, "Mysterious Markings; or, what not to do."

Zoological Society, Regent's-park, N.W., 5 p.m. 1. Professor H. M. Lefroy, "The House-Fly Campaign." 2. Mrs. H. L. M. Pixell-Goodrich, "*Minchinia*: a Haplosporidian." 3. Miss E. A. Fraser, "The Head-cavities and Development of the Eye-muscles in *Trichosurus vulpecula*, with Notes on some other Marsupials." 4. Dr. R. Broom, (*a*) "On the Organ of Jacobson and its Relations in the 'Insectivora.' Part II.—*Talpa*, *Centetes*, and *Chrysochloris*"; (*b*) "On the Anomodont Genera, *Pristerodon* and *Tropidostoma*."

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8.30 p.m. Colonel Sir Francis Younghusband, "India and the War."

WEDNESDAY, MAY 12...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. C. R. Darling, "Recent Progress in Pyrometry."

Metals, Institute of, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 8.30 p.m. Sir J. J. Thomson, "The Passage of Electricity through Metals."

Biblical Archæology, Society of, 37, Great Russell-street, W.C., 4.30 p.m. Mr. F. Legge, "The Legend of Mithras."

Automobile Engineers, Institution of, at the Institution of Civil Engineers, Great George-street, S.W., 8 p.m. Mr. A. Stubbs, "Drop Forging and the Automobile Industry."

Electrical Engineers, Institution of (Yorkshire Section), Philosophical Hall, Leeds, 7 p.m. Mr. J. H. Rider, "The Power Supply of the Central Mining-Rand Mines Group."

Auctioneers and Estate Agents' Institute, 34, Russell-square, W.C., 7.45 p.m. Presidential Address by Mr. J. T. Woolley.

Japan Society, 20, Hanover-square, W., 8.30 p.m. Mr. J. C. Hall, "The Structure of Japanese Society under the Tokugawa Shogunate (1603-1868)."

THURSDAY, MAY 13...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4.30 p.m. (Indian Section.) Sir C. H. Armstrong, "Indian Trade and the War."

Auctioneers and Estate Agents' Institute, 34, Russell-square, W.C., 3 p.m. Annual General Meeting.

Royal Institution, Albemarle-street, W., 3 p.m. Professor V. H. Blackman, "The Movements and Activities of Plants." (Lecture I.)

Optical Society, at the Chemical Society, Burlington House, W., 8 p.m. Mr. J. S. Dow, "Some Points in Connection with the Design of Searchlights and Projectors and the Visibility of Distant Illuminated Objects."

Iron and Steel Institute, at the Institution of Civil Engineers, Great George-street, Westminster, S.W., 10.30 a.m. Annual Meeting. 1. Mr. F. W. Adams, "Diffusion of Carbon in Iron." 2. Messrs. J. O. Arnold and G. R. Bolsover, "Supplementary Notes on the Forms in which Sulphides may exist in Steel Ingots." (Part II.) 3. Messrs. G. Charpy and A. Cornu, "Researches on Iron, Silicon, and Carbon Alloys." 4. Dr. J. A. Newton Friend and Mr. P. C. Barnet, "Corrosion of Iron in Aqueous Solutions of Inorganic Salts." 5. Dr. J. A. Newton Friend and Mr. C. W. Marshall, (*a*) "Relative Corrodibilities of Gray Cast Iron and Steel"; (*b*) "Note on the Removal of Rust by means of Chemical Reagents." 6. Dr. A. Greiner, "Communication on the Heating of an Open-hearth Furnace by means of Tar." 7. Sir R. A. Hadfield and Dr G. K. Burgess, "Sound Steel Ingots and Rails." 8. Mr. K. Honda, "The Nature of the A_2 Transformation in Iron." 9. Messrs. A. McWilliam and E. J. Barnes, "Brinell Hardness and Tenacity Factors of a Series of Heat-treated Special Steels." 10. Messrs. A. M. Portevin and E. L. Dupuy, "Thermo-electric Properties of Special Steels." 11. Dr. J. H. Smith and Mr. G. A. Wedgwood, "Stress-strain Loops for Steel in the Cyclic State." 12. Dr. J. E. Stead, (*a*) "Detection of Burning in Steel"; (*b*) "Iron, Carbon, and Phosphorus."

3 p.m. Professor H. Hubert, "Recent Progress in the Design of Large Blast-furnace Gas Engines."

FRIDAY, MAY 14...Iron and Steel Institute, at the Institution of Civil Engineers, Great George-street, S.W., 10.30 a.m. Annual Meeting continued.

Royal Institution, Albemarle-street, W., 9 p.m. Rev. E. H. Pearce, "The Archives of Westminster Abbey."

Malacological Society, Burlington House, W., 8 p.m. 1. Mr. G. C. Crick, "On a Dibranchiate Cephalopod (*Plesioteuthis*) from the Lithographic Stone of Bavaria." 2. Mr. J. R. le B. Tomlin, "Description of a New Species of *Zingis* from British South-west Africa." 3. Mr. G. K. Gude, "Diagnosis of a New Species of *Dyakia*."

Astronomical Society, Burlington House, 5 p.m.

Physical Society, Imperial College of Science, South Kensington, S.W., 8 p.m.

Mechanical Engineers, Institution of, at the Institution of Civil Engineers, Great George-street, S.W., 8 p.m. Professor A. H. Gibson and Mr. W. J. Walker, "The Distribution of Heat in the Cylinder of a Gas Engine."

SATURDAY, MAY 15...Royal Institution, Albemarle-street, W., 3 p.m. Professor F. Soddy, "Advances in the Study of Radio-active Bodies." (Lecture I.)

Journal of the Royal Society of Arts.

No. 3,260. VOL. LXIII.

FRIDAY, MAY 14, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MAY 17th, 8 p.m. (Cantor Lecture.) DAVID SOMMERVILLE, B.A., M.Sc., M.D., M.R.C.P., D.P.H., Assistant Professor of Hygiene and Public Health, University of London, King's College, "Foodstuffs." (Lecture IV.)

CANTOR LECTURES.

On Monday evening, May 10th, DR. DAVID SOMMERVILLE, B.A., M.Sc., M.R.C.P., D.P.H., Assistant Professor of Hygiene and Public Health, University of London, King's College, delivered the third lecture of his course on "Foodstuffs."

The lectures will be published in the *Journal* during the summer recess.

INDIAN SECTION.

Thursday afternoon, May 13th; The Most Hon. the MARQUESS OF CREWE, K.G., P.C., Secretary of State for India, in the chair. A paper on "Indian Trade and the War" was read by SIR CHARLES H. ARMSTRONG, late Chairman, Bombay Chamber of Commerce.

The paper and discussion will be published in a subsequent number of the *Journal.*

EXAMINATIONS.

A new system of publication of the results of the Examinations has been started this year. The candidates fill in a counterfoil attached to the paper on which they do their work; on these counterfoils the result of the examination is marked, and they are returned to the centres as soon as possible. By this means candidates are informed of the result of their examination some weeks sooner than in former years, when they had to wait until the printed results were issued. The results of the March Examinations in the Advanced and Intermediate Stages have now been sent to the centres concerned. The former were posted on April 24th and the latter on May 12th. The Examinations were held from March 22nd to March 31st.

The results of the Elementary Stage will be issued about the end of this month.

AMERICAN MAILS.

Fellows resident in America who may have addressed letters to the Society's office by the mail which should have been delivered in London on the 10th inst., are reminded that, in consequence of the destruction of the "Lusitania" by German pirates, those letters have probably been lost. It is therefore advisable that they should repeat the substance of their communications by a subsequent mail.

PROCEEDINGS OF THE SOCIETY.

TWENTIETH ORDINARY MEETING.

Wednesday, May 12th, 1915; SIR ROBERT ABBOTT HADFIELD, D.Sc., D.Met., F.R.S., in the chair.

The following candidates were proposed for election as Fellows of the Society:—

Bashiram, Sabgal, M.A., Assistant Engineer, P.W.D., Amritsar, India.

Sutton, E. Stanley, care of Manáos Harbour, Ltd., 11, Adelphi-terrace, W.C.

Wadleigh, Francis R., 426, Real Estate Trust Building, Philadelphia, Pennsylvania, U.S.A.

Williams, David D., 17, Montpelier, Edinburgh.

The following candidates were balloted for and duly elected Fellows of the Society:—

Balls, William H., Southern High School, Broad and Jackson-streets, Philadelphia, Pennsylvania, U.S.A.

Heath, Principal Lionel, I.E.S., Mayo School of Art, Lahore, Punjab, India.

Lau Chu Pak, Hon., J.P., 1, Babington-path, Victoria, Hong-Kong, China.

Stanley, William, Great Barrington, Massachusetts, U.S.A.

Turner, Walter V., Edgewood Park, Pittsburgh, Pennsylvania, U.S.A.

The paper read was—

RECENT PROGRESS IN PYROMETRY.

By Chas. R. Darling, A.R.C.Sc.I., F.I.C.,
Lecturer in Physics at the City and Guilds Technical College, Finsbury.

In the autumn of 1910 I had the honour of delivering four Cantor lectures before the Society on the subject of "Industrial Pyrometry," which contained an account of the appliances in use at that time. During the intervening period many improvements have been introduced, and many new instruments designed; and it is the object of the present paper to give an account of the chief advances made in pyrometry since the above date.

It is interesting to note, in view of the recognition of the value of scientific research forced upon us by the war, that, apart from the work of Government institutions such as the National Physical Laboratory, and the United States Bureau of Standards, practically all recent progress in pyrometry has been due to the efforts of instrument-makers, and little of importance has emanated from our educational institutions. At the present moment, most of our physicists are absorbed in atomic and molecular physics, to the exclusion of the industrial applications of their science. Hence it has been left to the manufacturers of pyrometers, chiefly in Britain and America, to furnish the improvements in methods, and to extend the applications of high-temperature measurements to the industries. The work accomplished in this direction deserves a much wider scientific recognition than it has received; and it is to be hoped that in the future any funds ear-marked for research will be spent largely on investigations definitely directed to the improvement of our industries. It is satisfactory to be able to state that, as the

Substance.	Physical Condition.	Temperature. °C.	Temperature. °F.
Water	At boiling point	100	212
Aniline	,, ,, ,,	184	363
Naphthalene	,, ,, ,,	218	426
Tin	,, melting ,,	232	450
Cadmium	,, ,, ,,	321	610
Lead	,, ,, ,,	327	620
Zinc	,, ,, ,,	419	786
Sulphur	,, boiling ,,	445	832
Antimony	,, melting ,,	631	1,168
Common Salt	,, ,, ,,	800	1,472
Silver (in reducing atmosphere)	,, ,, ,,	961	1,762
Gold	,, ,, ,,	1,063	1,946
Copper (graphite covered)	,, ,, ,,	1,083	1,982
Lithium metasilicate	,, ,, ,,	1,202	2,194
Nickel	,, ,, ,,	1,450	2,642
Palladium	,, ,, ,,	1,550	2,822
Platinum	,, ,, ,,	1,755	3,190
Tungsten	,, ,, ,,	(about) 3,000	5,432
Carbon arc		(,,) 3,500	6,332

result of scientific methods, British makers of pyrometers are not merely independent of other countries, but stand unrivalled in regard to the quality and accuracy of the instruments they supply.

During the period under notice no pyrometers based upon new principles have been introduced, and the advances made therefore relate to methods previously in use, which it will be convenient to consider under separate headings.

Standards of Temperature.

Various investigations of fixed points have resulted in the confirmation, or, at most, slight modification of previously-accepted figures. The table given on page 590 shows the values now generally recognised for purposes of standardisation, in terms of temperatures on the gas scale (omitting fractions).

Up to the highest reading at present obtainable directly on the gas-scale (1550° C.), these standards appear now to be well established. The melting-point of platinum, although arrived at by extrapolation, is probably correct to two or three degrees, and forms a very useful standard for the calibration of high-reading pyrometers.

All the foregoing fixed points refer to pure materials, and considerable errors may arise in graduating instruments unless the substances used are of a high grade of purity. Commercial materials are frequently unsuitable; antimony, for instance, may vary by 10° or more in melting-point from that of the pure metal. To overcome this difficulty, the United States Bureau of Standards now issues materials of certified fixed points, so that any user of pyrometers may check or re-calibrate his instruments with accuracy. This procedure might, with advantage, be followed by our own National Physical Laboratory, which is the centre of accurate pyrometer standardisation in this country. It has been suggested that a better plan is to keep an accurate, certified pyrometer for such purposes, and no doubt this is the case in very large establishments. In places where only two or three pyrometers are in use, however, the expense of a standard instrument, purely for testing, is not warranted; and it would be a great benefit to the small user if materials were available which he could rely upon to check the accuracy of his instruments. Instructions for use could be issued, so that, if they were followed intelligently, a correct result would be ensured.

Thermoelectric Pyrometers.

The past few years have witnessed a great extension of the use of base metals in the construction of thermal junctions. This has been due not merely to the almost prohibitive price of platinum and kindred metals, but to the fact that properly-chosen base-metal couples develop a relatively high E.M.F., and therefore enable a strong and cheap indicator to be used in place of the sensitive instrument required for couples of the platinum series. The chief base-metal couples in use in this country are composed as follows:—

Positive.	Negative.	Highest working temperature.	Maker.
Iron	Constantan	900° C.	All British firms.
Iron-nickel alloy	Iron-nickel alloy of different composition	1000° C.	R. W. Paul.
Nickel-chromium alloy	Nickel-chromium alloy of different composition	1200° C.	Foster Instrument Company.

For occasional readings, the last-named junction may be raised about 100° C. above the limit mentioned. For work at lower temperatures than 700° C., copper-constantan junctions

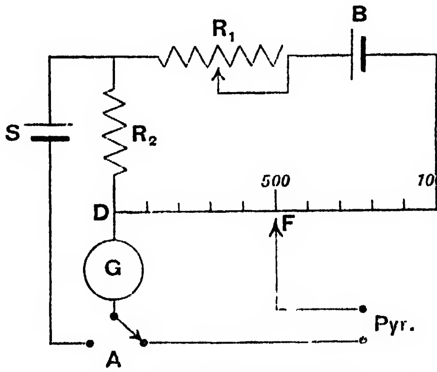

Fig. 1.—Potentiometer Indicator.

are frequently used, as, for example, in measuring the temperature of superheated steam. Numerous other combinations are used, particularly in the United States; amongst which may be mentioned couples of nickel-chromium and

iron-nickel, and iron joined with an alloy of nickel and aluminium.

Considerable doubt has been thrown on the reliability of base-metal junctions by Kowalke,* who investigated a number of couples supplied for commercial purposes by American makers. In all the cases examined sustained heating for twenty-four hours was found to alter the calibration by amounts varying from 20° C. to 130° C., the departure being most noticeable at the higher temperatures used—800° C. and 1000° C. Depth of immersion in the furnace was found to cause discrepancies in the indications, and the general results showed that large errors might arise owing to defects in the couples sent out by the makers. In some cases changes in the structure of one or both of the elements were detected by the aid of photomicrographs. With most of the junctions, however, it was found that prolonged heating induced a practically stable condition, and the conclusions to be drawn were: (1) the couple should be "aged" by continuous heating at its upper temperature limit before calibration; (2) the depth of immersion during calibration should be the same as that obtaining when the pyrometer is in use; and (3) metals which form solid solutions with one another give the best results. Since the publication of Kowalke's work, I have tested an iron-constantan pyrometer which has been in

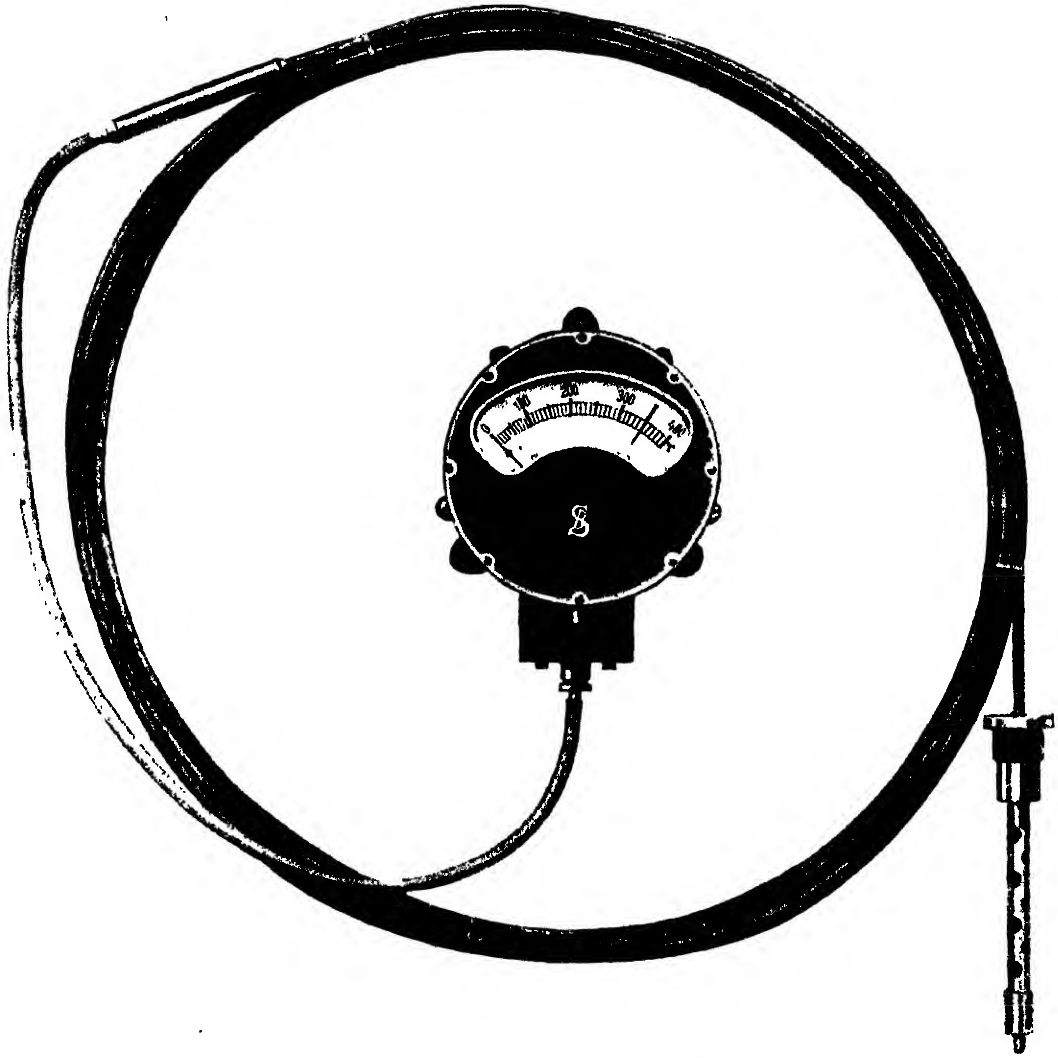

Fig. 2.—Siemens' Pyrometer for Superheated Steam.

* *Transactions* of the American Electrochemical Society, Vols. XXIV. (1913) and XXVI. (1914).

use in my own laboratory for nearly three years, during which time it has been repeatedly heated to 850° C. At the melting-point of zinc (419° C.) the calibration was strictly correct, and at 800° C. the reading was only 5° too low. This pyrometer is of the heavy type, made by welding a constantan rod to an iron tube, and the slight error thus shown after repeated use compares favourably not only with junctions made of platinum and its alloys, but with any type of pyrometer whatsoever. The general experience of users of base-metal couples of British manufacture is that the changes in calibration are much less than those recorded by Kowalke, which, if generally true, would entirely discredit this class of instrument.

An interesting investigation of junctions of carbon and graphite has been made by C. C. Bidwell,* who finds that by the aid of these materials temperatures as high as 2000° C. may be read. It is necessary to subject the junction to a preliminary heating at this temperature before calibration, in order to remove volatile impurities, when constant readings can be secured. Both carbon and graphite can be obtained in thick rods, and can be machined, so that it is possible to build up a robust pyrometer with these substances. If this couple be found to meet the requirements of industrial practice, it should prove extremely useful for temperatures exceeding 1200° C., and may solve the outstanding problem of determining the temperature of molten steel in the ladle. Its utility in experimental work is already established.

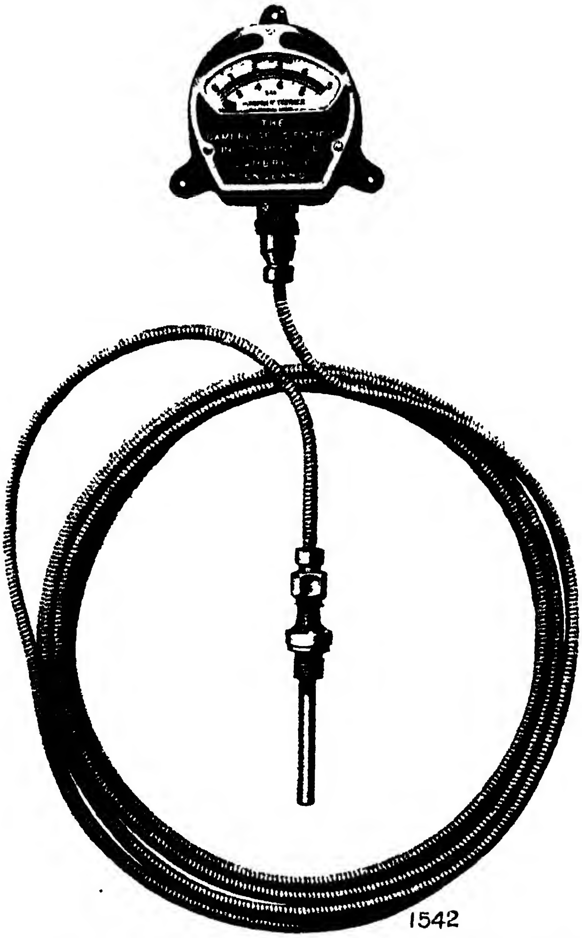

FIG. 3.—CAMBRIDGE SCIENTIFIC INSTRUMENT COMPANY'S PYROMETER FOR SUPERHEATED STEAM.

Several new materials have been introduced to form the protecting sheaths necessary to shield junctions from the corrosive action of furnace gases. Alundum (oxide of aluminium) is now

* *Physical Review*, June, 1914.

used for this purpose; but although it possesses a high melting-point (2050° C.) it is too permeable to gases, particularly at high temperatures, to be of general service. The same remark applies to a new material of the carborundum type, known as "silfrax," recently introduced in the United States. Another material with a carborundum basis, called "silit," is said to give satisfactory results. All the three substances named are brittle, and consequently cannot be subjected to rough usage. A new type of sheath, for use with molten brass or bronze, possesses a tip of molybdenum, connected to a nickel tube covered with a protecting material, so that only the molybdenum and the protection come into contact with the metal. As molybdenum is a good conductor of heat, and only a thin tube is used, a rapid reading of the temperature is obtained, the molybdenum being unacted on by the molten metal. This sheath is said to be entirely satisfactory for this purpose; if so, a troublesome problem in pyrometry may be regarded as solved. Foster's method, in which a junction of Hoskins' alloys is dipped directly into the molten brass, gives rapid readings, but the junction is gradually eaten away.

Much attention has been given by the various makers to the details of indicators, which in almost every case have been improved in the direction of reliability.

A new departure in the method of indicating temperatures in commercial instruments has been made by the Leeds and Northrup Company of Philadelphia, who have adopted the potentiometer principle, previously only employed for accurate laboratory work. The electrical connections of an instrument of this kind are shown in Fig. 1. A current from a two-volt accumulator B, passes through an adjustable resistance R_1, a fixed resistance R_2, and a uniform stretched wire DE. At the point D is attached one terminal of a sensitive galvanometer G, the other terminal being connected to one contact of the pyrometer P. The remaining wire of the pyrometer is fastened to a sliding-contact, F, which may be moved along DE. A standard cell, S, is permanently connected at C, and may be joined to the galvanometer when desired by means of the switch A. To commence with, S is connected to the galvanometer, and R_1 adjusted until no deflection is obtained. The switch is then turned over to the pyrometer, and the slider F moved along the wire until the deflection is again zero, when the fall of potential between D and F will be equal to the E.M.F. of the heated junction. From the relation

$$\frac{\text{E.M.F. of junction}}{\text{E.M.F. of standard cell}} = \frac{\text{Resistance of } DF}{R_2}$$

the E.M.F. of the junction is determined; and as the temperature corresponding to this is known by previous experiments, the point of balance on the wire may be marked with this temperature. Similarly, the whole length of the wire may be divided so as to read temperatures directly. It is essential to accuracy that the fall of potential along DE must not change; and as the voltage of the working cell B falls off with use, R_1 must be adjusted from time to time, so that when the standard cell is coupled to the galvanometer no deflection is obtained. The advantages possessed by an indicator of this kind are (1) great sensitivity, allowing the use of a large scale on which small differences of temperature may be read; and (2) the fact that the readings are independent of the resistance of the pyrometer, and its leads. On the other hand, an adjustment is necessary before taking a reading, and the working cell must be re-charged or renewed from time to time. A skilled observer could obtain closer readings than would be possible with an ordinary indicator, but in the hands of an untrained workman difficulties in use might easily arise.

Another adaptation of the potentiometer principle to indicators has been introduced by the Cambridge Scientific Instrument Company, with a view to obtaining closer readings over a given range. If an indicator be graduated from 0° to 1000°, and the working range be 500° to 1000°, the useful part only occupies one-half of the scale, and accuracy of reading is thereby restricted. If, however, it can be arranged that the pointer remain in the zero position until the pyrometer has reached 500°, the whole scale may then be used for the interval 500°–1000°, thus enabling finer readings to be taken. The way in which this may be accomplished may be understood by reference to Fig. 1. If the galvanometer, G, be replaced by an indicator, and coupled up so that the fall of potential between D and F opposes the movement of the pointer due to the pyrometer, no deflection will occur until this E.M.F. is overcome. If the value of the opposing E.M.F. be equal to that developed by the pyrometer at 500°, the pointer will only commence to move when this temperature is attained, and hence the whole scale may be devoted to the range 500°–1000°. Assuming that the indicator be sufficiently sensitive, it is evident that a full-scale reading could be

obtained for a less interval—say 200°—the commencing temperature being regulated by altering the position of the contact *F*. In one form of indicator arranged on this principle, the changes in the voltage of *B* are automatically compensated by the standard cell; in a simpler form, the standard cell is abolished, and the varying voltage of *B* allowed for by adjusting resistances in a circuit until the indicator, on being switched into this circuit, shows exactly full-scale deflection.

useful ranges on instruments furnished with double scale are appended:—

Junction.	Full Range. ° C.	Special Range. ° C.
Two iron-nickel alloys	0 to 1000	700 to 900
Platinum—Pt. Ir. . .	0 „ 1300	600 „ 900
Two rhodio-platinum alloys	1600	500 „ 1100

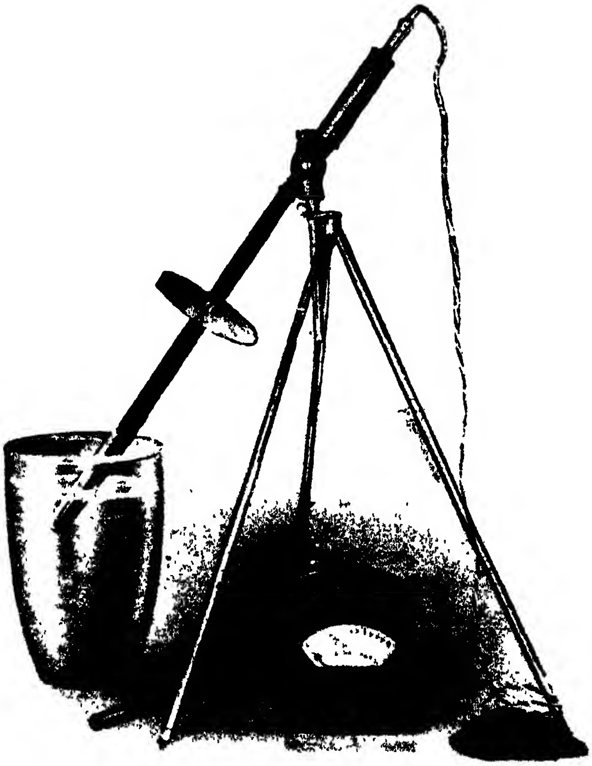

FIG. 4.—FOSTER'S RADIATION PYROMETER FOR MOLTEN METALS.

A similar result to the foregoing is attained by a different method in the instruments made by R. W. Paul. In these, the indicator takes the position of the galvanometer in a Wheatstone bridge, the pyrometer being in the indicator circuit. By adjusting the resistances in the arms of the bridge, a small current from the external battery may be caused to pass through the indicator so as to oppose that due to the pyrometer. This opposing current may, for example, be regulated so that the pointer of the indicator remains at zero until the pyrometer has attained 500°, thus leaving the whole scale available for graduation from 500° upwards. Examples of

Combined with this Wheatstone bridge arrangement is a device for correcting automatically for changes in the temperature of the cold junction. In the four arms of the bridge two of the resistances are of manganin, which are unaffected by temperature changes, whereas the other two are of copper, which alters in resistance on heating or cooling. The bridge is accurately balanced at 20° C., but at any other temperature a small current will pass through the indicator, the direction of which will depend upon whether the resistances have been raised or lowered in temperature. The cold junction is located so as always to possess the same temperature as

the resistances, which are regulated so that the movement of the indicator pointer, when the bridge is out of balance, covers an amount of the scale representing the difference between 20° and the temperature of the cold junction. This compensation is arranged to hold either for full or special range.

indicator unaffected by vibrations is requisite, and can now be supplied by the various makers. Altogether, it will be seen that noteworthy progress has been made in this branch of pyrometry, most of the difficulties which militated against accurate and concordant results having been removed.

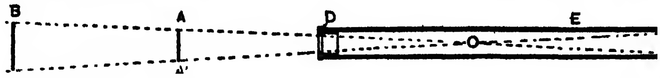

FIG. 5.—PRINCIPLE OF PAUL'S RADIATION PYROMETER.

A mechanical "hold-up" for special range work has recently been devised by the Cambridge Scientific Instrument Company. In this case the indicator possesses a suspended coil, and by turning a graduated head a twist is imparted to the suspension, opposing that due to the current passing from the pyrometer through the coil. By turning the graduated head to a given mark, the zero of the indicator may be made to represent say 500°, and the whole scale used for the remainder of the range.

The general use of superheated steam in engines, including locomotives, has opened a wide field for the useful application of pyrometers. In this instance it is necessary to arrange the pyrometer to withstand pressure, and to provide fittings whereby it may be fastened to a steam-pipe. Thermal junctions of

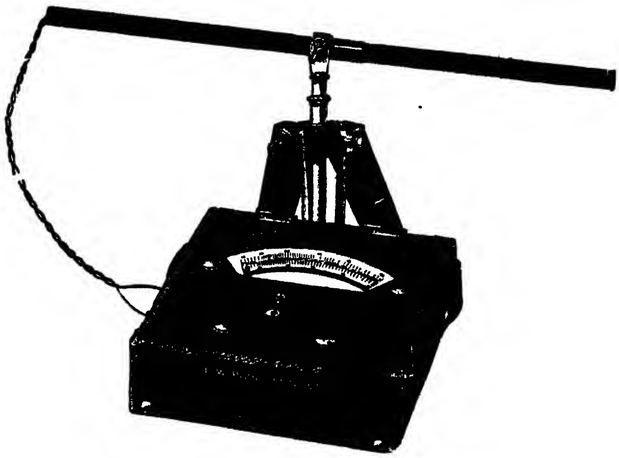

FIG. 6.—PAUL'S RADIATION PYROMETER.

copper and constantan are usually employed, and the arrangement of the fittings is shown in Figs. 2 and 3, which represent instruments of this type made by Messrs. Siemens and the Cambridge Scientific Instrument Company respectively. Similar pyrometers are made by Foster and Paul. In the case of locomotives, an

RESISTANCE PYROMETERS.

There are few changes to record in connection with this class of instrument, the patterns in use five years ago having undergone little modification. Platinum, which is the metal invariably used, has been shown recently by Sir William Crookes to be measurably volatile above 1000° C., and this explains fully why the readings of these pyrometers went astray when a continuous temperature above this figure prevailed in the furnace. For work at low temperatures, such as occur in connection with cold storage, and also for use in chemical operations at moderately high temperatures, the resistance pyrometer is to be preferred on account of its greater accuracy, and its use for such purposes is extending rapidly. An installation, consisting of a number of instruments connected to a single indicator through a switchboard, is now a common feature in cold stores or up-to-date chemical works. By its aid the attendant can read the temperature at any point by switching the pyrometer located at the spot on to the indicator, and the accuracy of the reading may be either 1° or less if desired. For metallurgical

work, resistance pyrometers find an application in cases where great accuracy is essential, and where provision is made to secure a precise adjustment of the temperature of the furnace. A common practice in large establishments is to use thermoelectric instruments for the ordinary work, but to keep one or more resistance pyrometers for specially accurate work, and for checking the various indicators in general use. This is sound practice, as it makes the best use of both systems.

Reference may be made here to the interesting researches of Northrup,* which give promise of an extension of the resistance method to a range of temperature beyond its present limit of 1000° C. Northrup found that certain metals, such as copper, increase steadily in electrical resistance up to the melting-point, and that in the process of melting the resistance is doubled in value, after which the resistance of the molten metal increases uniformly as the temperature rises. It may be possible to devise an instrument in which the temperature is deduced from the resistance of a molten metal; if so, the range of resistance pyrometers could be extended to at least 1400° C., and higher than this if a protecting sheath capable of withstanding a greater temperature could be found. Another possible extension of the resistance method is suggested by the change in resistance shown by pyro-conductors with rise of temperature. These bodies, of which glass is an example, decrease in resistance with rise in temperature; thus alundum, at 1100° C., has a resistance of 6,100 ohms per cm. cube, which falls to 190 ohms at 1600° C.—an average decrease of nearly 12 ohms per degree. A very coarse instrument would readily detect a change of this order, and further investigations in this direction may lead to a pyrometer based on this phenomenon.

* *Journal* of the Franklin Institute, January and March, 1914.

Radiation Pyrometers.

The drawbacks incidental to the use of thermoelectric pyrometers for temperatures exceeding 1000° C. have led to a wide adoption of the radiation method in processes involving readings above this point. The Féry pyrometer, made by the Cambridge Scientific Instrument Company, is extensively used, and has been improved in details. In the early form, a suspended-coil galvanometer was necessary as indicator, owing to the low E.M.F. developed by the junction on which the rays were focused. The use of an alloy of antimony and zinc, in atomic proportions, as one of the junction materials, has enabled pivoted indicators to be used, owing to the greatly increased E.M.F. obtained, which is a great advantage from the standpoint of portability. The gilt mirror formerly used has been superseded by one of a special alloy of higher reflecting power; and the focusing head graduated so that, without sighting, the pyrometer may be focused for any desired distance. Whipple has applied this pyrometer to the determination of the temperature of molten metals by mounting it at the open end of a fireclay tube, the closed end of which is dipped into the metal, and kept permanently in focus. By this means readings as high as 1500° C. have been taken in small ladles, but so far it has not been found possible to apply the method to large masses which cannot be approached closely.

Foster's fixed-focus instrument has also proved quite satisfactory for general workshop requirements, and has found many applications. Fig. 4 shows this pyrometer as used for molten

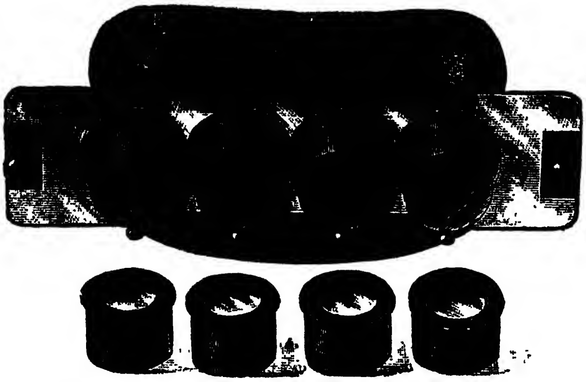

Fig. 7.—Becker's Extinction Pyrometer.

metals, attached to a fireclay tube, the closed end of which is immersed in the material. A feature of this arrangement is the vertical ventilating tube in front of the mirror, which prevents metallic fumes rising from the fireclay tube, in case of breakage, from entering the upper end of the telescope, and thus avoids any damage which might arise from this cause. Being mounted on a light tripod, the instrument is portable, and can be adjusted in height as required. A pivoted indicator is used. A special form of this pyrometer, designed for lower ranges, such as 500° C. to 1000° C., can now be procured. Another form of fixed-focus pyrometer, due to Thwing, has been marketed by R. W. Paul.

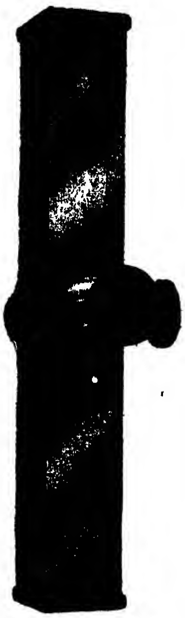

FIG. 8.—ALDER AND COCHRANE'S EXTINCTION PYROMETER.

The principle of working is shown in Fig. 5, where E is a tube containing a polished cone, C, at the apex of which is fixed a thermal junction, T. Rays from the hot source AA' enter the tube at D, and pass into the cone, being finally reflected on to T, which is connected to the indicator. So long as the lines joining the outside of the cone with the extremities of the entrance D, crossing at O, fall within the hot source, AA', the reading will be the same at all distances. Fig. 6 shows the actual pyrometer, mounted on a tripod, with a unipivot galvanometer as indicator, the scale, as in all radiation pyrometers, being divided into temperatures according to the fourth-power law.

The certificates issued by the National Physical Laboratory with radiation pyrometers of all the types mentioned indicate the high degree of skill shown by the makers. The corrections are invariably small, and sometimes non-existent.

Mention may be made here of the results of various determinations of the value of the constant K in the radiation formula

$$E = K(T_1^4 - T_2^4)$$

where E is the energy radiated by a black body in watts per square centimetre. Using the accurate pyrometers now available, the value for K has been found to be $5 \cdot 6 \times 10^{-12}$.

OPTICAL PYROMETERS.

The standard forms of optical pyrometers due to Féry, Wanner and Holborn & Kurlbaum

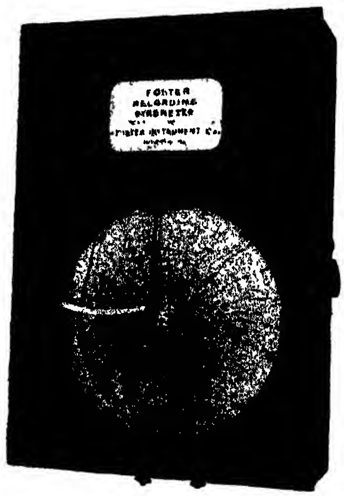

FIG. 9.—FOSTER'S RECORDER.

are now well established, and have been improved in detail for greater convenience of reading in the workshop. A new type of instrument has come into use, based upon the principle of colour extinction. By interposing a solution of correct colour and density between the eye and the heated source, all luminous rays may be extinguished. The instrument sold by F. E. Becker & Co. is shown in Fig. 7, and consists of an eye-shade, in which prepared cells, corresponding to known temperatures, may be fitted. Double vision is used, being better suited to prolonged observation. To control a furnace so as to attain a desired temperature, observation is made through the appropriate pair of cells from time to time, until a faint red image is seen, when the heat supply is regulated so as

to maintain a constant temperature. A second pair of cells in the eye-shade correspond to a temperature a few degrees higher than that required, and on looking through these the field should appear dark. In this manner a very close approximation is obtained, and the apparatus finds a useful application in the hardening of steel and other processes which involve the production of a steady temperature. A form of this pyrometer has been issued consisting of a single cell, in which the thickness of the layer of liquid may be adjusted, and graduated in temperatures corresponding to the thickness.

A second form of colour-extinction pyrometer has been introduced by Alder and Cochrane (Patent No. 27,633, 1913). This is shown in Fig. 8, and consists of a small telescope, the rays through which are intercepted by a coloured prism, which may be moved up and down so as to interpose any desired thickness in the path of the rays. In using the pyrometer, the heated object is focused in the telescope, and the prism moved until a completely dark field is obtained. A temperature reading is then indicated opposite a fixed pointer on a scale which moves with the prism. Using this instrument on a filament lamp, I have found a good agreement in the readings obtained by different observers; and being simple in construction and small in size this pyrometer should prove very useful to foremen and others in charge of furnaces. To increase the range, a piece of suitably tinted glass is inserted in the eyepiece, readings being taken from a scale prepared with the glass in position.

A promise of a new form of optical pyrometer is conveyed in a paper read by Paterson and Dudding before the Physical Society in March, 1915. They showed that the temperature of many metallic substances could be measured accurately by matching the colour against that of a black body until equality was obtained, the temperature of the black body being varied until the colours, viewed in the field of a Lummer-Brodhun photometer, were identical. Filament lamps, with an ammeter and rheostat in circuit, were brought to colour equality at various current strengths with the standard black body, the temperature of which was assigned to the filament at each adjustment. The lamps thus became secondary standards, a given current corresponding to a given temperature. Using a carbon filament lamp thus standardised, and adjusting it to colour equality with platinum at its melting-point, the temperature indicated was 1750° C.—a very close approximation to the accepted figure. We may reasonably expect our instrument-makers to produce an optical pyrometer on these lines, suited to industrial purposes.

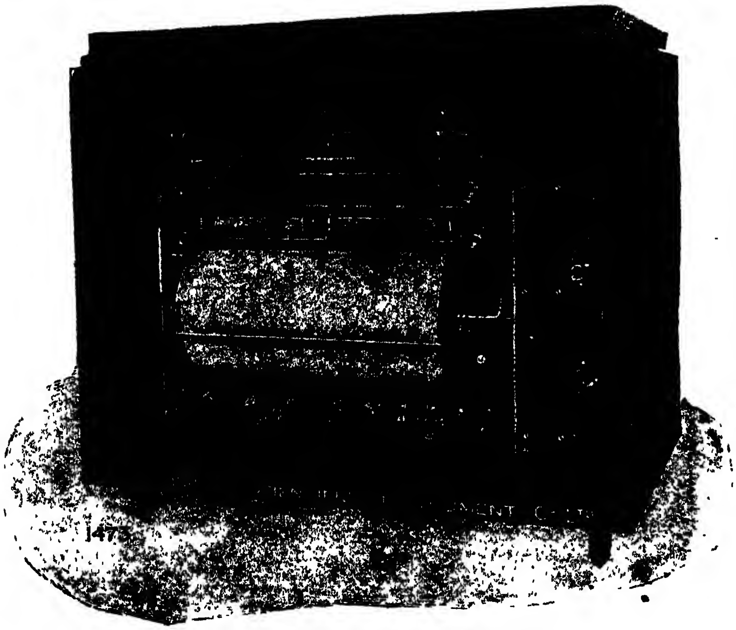

Fig. 10.—Double Thread Recorder.

Mr. Lovibond has suggested a colour-matching pyrometer of a different kind. Using a frosted glass field illuminated by a filament lamp as a standard surface, and interposing tintometer glasses, equality of tint could be obtained with

a heated source at a lower temperature. Standardisation could be carried out by means of a black body at known temperatures, and the values assigned to the tinted glass combinations required to produce equality of hue. In a trial of this method Mr. Lovibond and myself found it to be very sensitive; but, so far as I am aware, he has not followed it further.

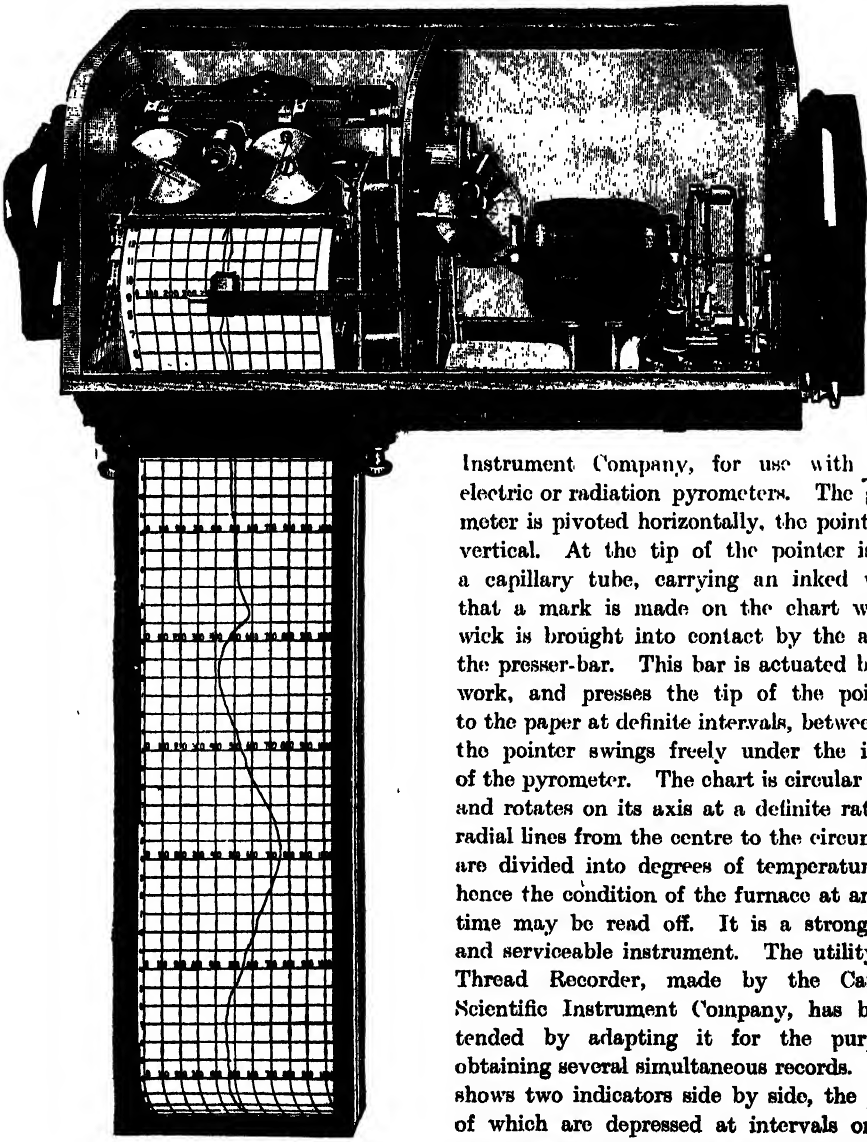

FIG. 11.—PAUL'S RECORDER.

RECORDERS.

The advantages of continuous records of furnace temperatures have been widely recognised during the last few years, and in consequence developments in this branch of pyrometry have been extensive. The modern form of the Roberts-Austen photographic recorder, made by the White Instrument Company, is used in many places; but the modern tendency is in favour of inked records, which are always visible, and require no photographic treatment. A brief description of the newest forms must suffice on the present occasion.*

Fig. 9 shows the recorder made by the Foster Instrument Company, for use with thermo-electric or radiation pyrometers. The galvanometer is pivoted horizontally, the pointer being vertical. At the tip of the pointer is placed a capillary tube, carrying an inked wick, so that a mark is made on the chart when the wick is brought into contact by the action of the presser-bar. This bar is actuated by clock-work, and presses the tip of the pointer on to the paper at definite intervals, between which the pointer swings freely under the influence of the pyrometer. The chart is circular in form, and rotates on its axis at a definite rate. The radial lines from the centre to the circumference are divided into degrees of temperature; and hence the condition of the furnace at any given time may be read off. It is a strongly-made and serviceable instrument. The utility of the Thread Recorder, made by the Cambridge Scientific Instrument Company, has been extended by adapting it for the purpose of obtaining several simultaneous records. Fig. 10 shows two indicators side by side, the pointers of which are depressed at intervals on to an inked thread, which touches the chart and makes a mark. A double chart is mounted on a single drum, which rotates by clockwork, and a separate pyrometer may be coupled to each indicator. When four records are required

* For a fuller account of recording pyrometers, see a paper by the author in the *Transactions* of the Faraday Society, 1914.

simultaneously, two threads, wetted with inks of different colour, are used; and by an automatic arrangement the pointer may be made to descend on each thread in turn. Two pyrometers are connected to each galvanometer, and are brought into circuit in turn, so that the records of each appear in a different colour; and thus four records in all can be secured on the same chart. It may be used for thermoelectric or radiation pyrometers. The Leeds and Northrup Company, of Philadelphia, have introduced a recorder which is actuated by an electric motor, instead of clockwork, and which may be used for resistance or thermoelectric instruments. A boom from the coil of a galvanometer is placed between a system of levers, and when on either side of the central position it enables the levers to engage and to cause a disc to rotate. The effect of the rotation is to readjust matters so that the boom is restored to the central position. Used with a resistance pyrometer, the moving disc alters the resistance in one arm of a Wheatstone bridge until a balance is obtained, when the boom assumes the central position and the levers fail to engage. When connected to a thermoelectric pyrometer, the movement causes an arm to move over a potentiometer wire (Fig. 1), until the E.M.F. due to the pyrometer is counterpoised, when the boom will become central. The movements of the disc are communicated, by suitable mechanism, to a pen moving over a chart. This recorder is much used in the United States, but has not yet been adopted in Britain.

The motor-drive has also been applied in the recorder made by R. W. Paul, which is illustrated in Fig. 11. A special device is used to ensure a constant speed of rotation in the motor, which, by suitable gearing, actuates the chart and presser-bar. The pointer of the galvanometer is pressed periodically on to an inked ribbon, beneath which is placed a thin metal rod over which the chart passes. The speed of the various movements may be altered by changing the gear. A unipivot galvanometer is used when records of thermoelectric or radiation pyrometers are being made; and when a resistance pyrometer is employed a Harris indicator is used instead of the galvanometer. The lower extension of the recorder enables a considerable length of chart to be inspected. Multiple records may be secured with any type of pyrometer; and specially useful features are: (1) The provision of metal-faced joints in the cover, which makes the recorder dust-proof; (2) the construction of the apparatus in separate units, each of which is easily replaceable; and (3) the use of the motor in place of clockwork, which enables a greater power to be used in actuating the various parts.

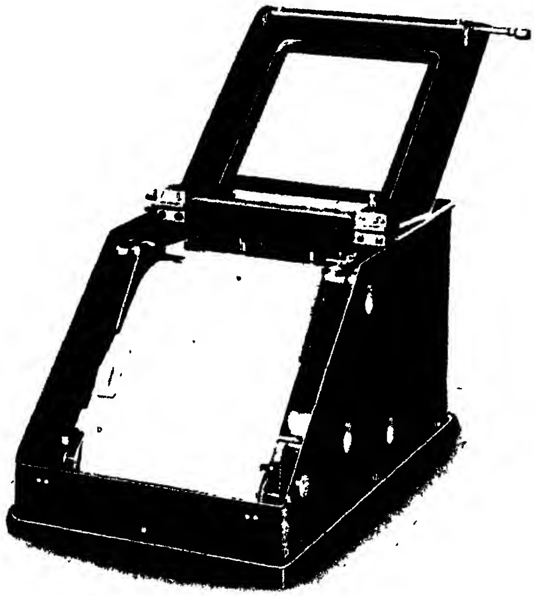

FIG. 12.—SIEMENS' RECORDER.

Messrs. Siemens and Company, who were the first to introduce an ink recorder, have recently

introduced several improvements in their instrument. The case is now constructed entirely of metal, jointed so as to be dust-proof. A pivoted galvanometer is used, and the pointer, made of thin metal, is pressed down periodically on to an inked ribbon, beneath which is placed a metal knife-edge over which the chart passes, so that a small dot is made at each contact. The case is made with a sloping front in which a window is inserted (Fig. 12), thus enabling a large portion of the record to be seen at a glance. This front is hinged to permit of access to the clockwork, which is made in three separate parts, controlling respectively the forward movement of the chart, the ascent and descent of the presser-bar, and the movements of the rollers on which the record-paper is wound. Robust construction and small size are features of this recorder.

Conclusion.

It will be seen from the foregoing that a substantial advance has been made in the production of instruments for measuring and recording high temperatures since the subject was previously before the Society. At the present time, when all and sundry are in search of methods of adding permanently to our industries, the example furnished by the manufacture of pyrometers may be cited as a useful guide to success in this direction. All the establishments in which pyrometers are made in this country are under the direction of thoroughly skilled scientific men, who are constantly devising new instruments with a view to greater efficiency and a wider field of application. All are in close touch with the National Physical Laboratory, which has proved invaluable to them in regulating the calibration of their instruments, and securing a uniformity which is now comparable to that which exists in thermometers. The result is a thriving and constantly extending industry, not threatened by foreign competition, and not in need of artificial props to ensure its success. The instruments exhibited to-night, all of British manufacture, cannot be surpassed, or probably equalled, by any other country; and are examples of what may be accomplished by the intelligent application of science to industry.

[Apparatus in illustration of the paper was exhibited by the Cambridge Scientific Instrument Company, Mr. R. W. Paul, the Foster Instrument Company, Messrs. F. E. Becker & Co., Messrs. Cochrane & Co., and Messrs. Townson & Mercer.]

DISCUSSION.

The Chairman (Sir Robert Abbott Hadfield, D.Sc., F.R.S.), in opening the discussion, said his first experience of a pyrometer was that of a blacksmith named "Joe." Joe was a very good pyrometer indeed. He (the Chairman) used to take him various pieces of steel in his earlier days of experiments on alloy steel; and it was marvellous how very closely Joe could take the temperatures. It only showed how high the human intelligence was, even if not aided by scientific apparatus. With reference to the interesting subject of pyrometers, when looking back during the last twenty years it was astonishing to note the progress which the development of that branch of science had enabled metallurgists to accomplish. To-day not only did the pyrometer represent highly specialised scientific apparatus, but it was practical, and with hardly any practice could be handled with success by those who had had even but little experience. He had been recently looking over one of his own papers read before the Institution of Civil Engineers in 1899, "The Influence of Casting Temperature upon Steel," in which the question of determining temperatures was at that time dealt with. The question of how to estimate temperatures by accurately observing the various shades of colours in heated objects was then being discussed. No doubt that method was useful; human eyes, however, varied, and two observers trying to observe the temperature of the same heated object generally arrived at quite different conclusions. It was therefore in that respect that the great work done by the well-known Frenchman, Professor Henri le Chatelier, had proved invaluable. Professor Le Chatelier was unusually modest. Beyond expressing gratification at the result of his researches, he himself had not claimed to be a pioneer. On the other hand, however, all those who had studied the question knew that, had it not been for his work, it was more than probable that this branch of metallurgy would not be in the high state of perfection it had now reached. Speaking in a general way, Wedgwood in 1782, with his fireclay pyrometer, was probaby the first to call attention to the importance of correctly determining temperatures. That was the result of his work in connection with pottery. There was then a long interval, during which little was done until the late Sir William Siemens took up the question of determining temperatures by means of measuring the varying electrical resistance of platinum wire submitted to different temperatures. Another of his methods was the use of a copper ball placed in the furnace the temperature of which was desired to be obtained. The ball was taken out and rapidly quenched, the rise of temperature of the water in which the ball had been immersed being observed; from that a rough determination of the temperature was obtained. That method was used for a long time with success. Le Chatelier then came forward with his remarkable scientific work, and practically

started the modern electric resistance pyrometer. Excellent work was done in this country by Sir W. C. Roberts-Austen—who was ably helped by Mr. H. C. Jenkins—with his recorder, and also by Mr. H. L. Callendar, by whose accurate instrument it was possible to determine temperature to exceedingly fine points, less than 0·1 of 1° C. As showing the extremes of temperature which had been measured, it might be mentioned that Professor K. Onnes had been down to within 1½° of the absolute zero. On the other hand, Mr. O. Lummer claimed to have reached as high as 6000° absolute (about 5800° C.), by impregnating the carbons and the arc, and working it under high pressure, that artificial temperature of course approximating to that of the sun. The low temperatures reached by Professor Onnes had brought out some remarkable physical facts—including the almost complete absence of electrical resistance in certain metals at those temperatures. Dr. Whipple, of the Cambridge Scientific Instrument Company, had done most useful work in developing the manufacture of both electrical and optical pyrometers, the latter being a comparatively new application and now largely made use of; also Johnson and Matthey, who had been to such great pains in providing pure platinum and platinum alloy ingots of the correct composition; and Dr. G. K. Burgess of the United States Bureau of Standards, Washington, D.C. Incidentally, he was glad to say that Dr. Whipple, acting under strong advice which he put before him, was now in a position to turn out pyrometers for the supply of which we had hitherto been dependent upon the Continent. They were now "made in England." In 1904 an excellent exhibition of pyrometers suitable for metallurgical work was held before the Iron and Steel Institute. Fifteen different kinds of electrical and optical instruments were exhibited, and a useful discussion took place, so that anyone who wished to refer to what was done up to that date, 1904, would find full references and information, including an excellent bibliography. Nearly all the developments of special steel were due to the possibility of now being able to determine temperatures varying from a few degrees to 1200° C. or more. The manufacture of modern armour, projectiles, guns, material, and so on, was now practically dependent upon accuracy of temperature observation. In that respect it might be of interest to read the following from former papers of his own: "With regard to the sensitiveness of iron to changes of temperature 'upwards,' that was in the form known as 'carbon steel,' the fact pointed out by Mr. S. N. Brayshaw in some excellent research work carried out a few years ago, might be mentioned, namely, that at certain physical temperatures a difference of even one degree Centigrade would considerably modify the physical qualities of the steel being treated. Mr. Brayshaw had given good evidence of that in his work. Moreover, it was known that ordinary carbon steel of tool-steel grade quenched at 725° C. would bend considerably, and had a Brinell hardness number of 228. Quenched at 735° C., the same material would only bend 1°·5, the hardness number being increased to 512. Quenched at 740° C., or only 5° C. higher, the bend was *nil*, and the hardness number was increased to the high figure of 713. Thus there was the remarkable fact that by increasing the temperature only 15° C., one had the phenomenon of complete hardening. The small difference of 15° C. (27° F.), within which range hardening or non-hardening results occurred, represented no more than the change in temperature between a spring and a summer day, yet such slight differences in temperature entirely revolutionised the structure of steel. As a further illustration of the significance of accurate temperature determination, it had been pointed out by Professor S. W. J. Smith, F.R.S., and Mr. J. Guild, in an excellent paper entitled "A Thermo-magnetic Study of the Eutectoid Transition Points of Carbon Steels," that in a difference of only about 4° Centigrade, complete revolution took place in the magnetic qualities of iron. For example, the thermo-couple temperature was kept steady for several minutes at 733° C. in one case without alteration in the magnetometer deflection which differed very little from that at 730° C. The furnace temperature was then raised very slightly, and, *before* the thermo-couple reached 734° C. a rapid fall of magnetisation set in. In other words, that important revolutionary change in iron could only be determined by the aid of very accurate pyrometers. There was still one domain in which we were not very sure about temperature observations, that was when we got up to 1400° C. and higher. Molten mild steel had a temperature of about 1580° C. Whilst it was not impossible to determine that accurately on small specimens, that was in laboratory work, there were still no very correct means of determining temperatures in fluid steel of large mass. That same difficulty therefore still existed which he had called attention to in the discussion on Sir William Robert-Austen's paper on his recording pryometer before the Iron and Steel Institute in 1893, that was to say, couples exposed to high temperatures were liable to become very brittle and, when immersed in fluid steel, disintegrated. Whilst in optical pyrometers they gave useful service, there were many sources of inaccuracies in such observations still to be cured. With reference to what were called high temperatures, and showing how puny they were, Dr. Northrup had pointed out that Arrhenius speculated that the petty ranges of temperature in which matter was studied represented about one-sixty thousandth of the total range of temperature in which the matter of our solar system existed. Sir William Roberts-Austen, in the discussion of one of his papers, suggested, as an answer to a question put by Dr. Stead, that the end of the couple might be protected by a cap of zirconium, or by some metallic cap not actually touching the couple. This had not, however, been found of

service in practice, so there was still room for other metallurgists at the present time to improve considerably the practice in this respect. Whilst speaking on the question of Centigrade temperatures, it would be of the greatest service throughout the world if that method of indicating temperatures could be accepted instead of that occasionally done of using Fahrenheit or other scales. In American technical and even scientific papers reference was often made to temperatures in Fahrenheit scale. This was most perplexing, and he was sure those who learnt to think in Centigrade temperatures would never regret it, that method being in every way superior to the older one. It would be of great advantage if all countries came to an agreement to abolish the Fahrenheit scale altogether. He should like to refer to the excellent work being done by the National Physical Laboratory, showing that this country was alive to all the necessary advances to be made in this scientific work. Under Dr. Harker's able guidance they were investigating the following points, amongst others, relating to temperature determination: (*a*) fundamental temperature scales; (*b*) proposed international thermo-dynamic scale as realised through the intermediary of the resistance thermometer; (*c*) high temperature scales; (*d*) thermal conductivity and emissivity of heat insulators; (*e*) heat loss from surfaces; (*f*) general research on refractories; (*g*) specific heat of gases at high temperatures; (*h*) specific heat and latent heat of fusion of metals. In a general way, speaking from many years' experience, the following represented the experience of the laboratories in Sheffield. With reference to the best form of couples, nothing had been found for all-round service to supersede platinum and platinum-rhodium. There were some good base metal couples, but they were not serviceable for high temperatures. He found it best to use resistance wires of the platinum alloys throughout. The use of those couples was not so expensive as might at first sight seem to be the case, because the scrap platinum from high temperature work was useful for low temperature work. With regard to the various forms of pyrometer instruments, platinum resistance pyrometers were too sluggish for quick readings, not suitable for high temperatures, and were costly to repair. It had been found that the thermoelectric type was the best. The vital point about those had been to get an instrument of sufficiently high resistance made up of a material which would not vary with fluctuations of atmospheric temperature. High resistance was absolutely necessary to swamp the changes in resistance of the circuit when using different lengths of couple. Makers were now waking up to this, and the Cambridge Scientific Instrument Company, Siemens Brothers, and the Beighlee Company of America, were found to be quite satisfactory in that respect. Carpentier, of Paris, also made an excellent instrument, having 1,000 ohms resistance, entirely of German silver, and giving a scale 18 ins. long. It had been found essential for accuracy to keep the instrument in a fixed position and calibrate it *in situ*. With regard to recording pyrometers, there were very few instruments on the market of sufficiently high resistance, and nothing had been found to beat the Roberts-Austen photographic recorder, made by the White Instrument Company, for serviceability. With regard to calibration, he strongly emphasised the desirability of calibrating with standard melting and boiling points, in preference to relying upon the makers' calibration or on standard couples. As an example of the cost of platinum and platinum-rhodium wire as used in modern pyrometers, he might say that his firm, in 1913, spent on platinum and platinum-rhodium wire £370, in 1914, £415, and the expenditure for this year would probably be about £600. They made many thousands of determinations each week. If any one of these were inaccurate it would mean bad work and the loss of hundreds of pounds. That would give some idea of the importance of pyrometer work. Before leaving that particular aspect of the subject reference might be made to the important question of the necessity of thoroughly and accurately standardising the various instruments and apparatus employed in determining high temperatures. That matter had been very fully dealt with in a most valuable paper by Dr. E. F. Northrup in June, 1912, entitled "Temperature and the Properties of Matter." Dr. Northrup pointed out the excellent work done in platinum resistance pyrometry by the Bureau of Standards, Washington, D.C.; Dr. G. K. Burgess had given most valuable aid in this branch of science, and was to be heartily congratulated on the work he had accomplished. In the above-mentioned paper Dr. Northrup pointed out the fixed temperature points at which standard substances melt, and which formed a temperature scale by which temperature-measuring devices may be calibrated, as given in the following list:—

Ice, m.p.	0·0°
Water, b.p.	100·0°
Naphthalene, b.p.	217·7°
Benzophenon, b.p.	305·4°
Cadmium, m.p.	320·2°
Zinc, m.p.	418·2°
Antimony, m.p. (in CO)	629·2°
Silver, m.p. (in CO)	960·0°
Gold, m.p.	1062·4°
Copper, m.p. (in CO)	1082·6°
Diopside, m.p.	1391·2°
Nickel, m.p. (in N_2)	1452·3°
Cobalt, m.p. (in N_2)	1489·8°
Palladium, m.p.	1549·2° within ± 2° C.
Platinum, m.p.	1755·0° within ± 5° C.

With those fixed points assigned, any thermo-couple of platinum and platinum-rhodium might have its curve of temperature against thermal E.M.F. determined in any part of the world, when it in turn became a secondary standard for the

measurement of temperature to the melting-point of platinum within an accuracy at the upper limit of approximately 5°. In the paper already mentioned, which he (the Chairman) read in 1899 before the Institution of Civil Engineers, he referred to the fact that at that time it was stated by the able American metallurgist, Mr. H. H. Campbell, in his excellent paper "On the Open-Hearth Process," that even a difference of 20° C. to 30° C. caused considerable changes in the behaviour of molten steel during casting. Although that had not entirely been borne out in practice there was no doubt something in the claim. It would therefore be understood how important it was that a thoroughly practical pyrometer should be perfected, so that small differences at high temperatures should be enabled to be detected. Mr. Campbell stated that the addition of 100 lbs. of scrap to a seven-ton bath of steel would cause the temperature to fall about 16° C. or 20° C., and that change of temperature was perceptible to the naked eye. Speaking of temperatures by colour scale, he (the Chairman) had prepared the following information in comparison with the figures given by other observers. It might be of interest to give a table of the figures:—

Table of Temperatures by Colours.

Hadfield.		Pouillet		Bowker.	
Colour	Temp.	Colour.	Temp	Colour	Temp.
	°C.		°C.		°C.
White (not welding heat)	1240	White	1300	White	1204
High yellow	1130	Orange heat	1100	Very bright red	1010
Yellow	1081	Cherry red	800	Bright red	926
Low yellow	971	Red heat	525	Full red	804
Bright red	923			Red heat	650
Medium red	795				
Blood red	667				

Column No. 1 represented his results obtained by means of a Le Chatelier pyrometer, suitably protected in the furnace. That pyrometer was an admirable one so long as it did not come in contact with molten metal. Column No. 2 represented similar comparative temperatures taken from Pouillet's tables. Column No. 3 represented comparative temperatures prepared by the American expert. Finally it would be seen how much modern metallurgical progress, especially with regard to alloy steel, depended upon the accurate determination of the temperature employed.

Mr. Charles E. Foster complimented the author upon the stress which he had laid on the practical application of the pyrometer. The temptation of anyone with the high technical qualifications of the author must be to examine and dwell upon the ingenious and pretty pieces of design rather than direct and simple application to industrial processes. So far as his own experience went, he thought the pyrometer-maker was ahead of the furnace-maker in so far as the control of temperature was concerned. The pyrometer-maker could measure to a finer degree of accuracy than the furnace-maker could make a furnace to maintain that temperature. Although he did not want to shift the blame on to the shoulders of the furnace-maker, he thought it was up to the latter to make the next move. It was a very difficult question for the instrument-maker to answer as to what instrument the user should have. As a physicist, the maker was tempted to offer a thing having the higher intrinsic accuracy, but that might not necessarily produce the best result in the hands of the user, because the user might not be able to give it the right kind of conditions of use. With reference to the question of stability of the base metal thermo-couple junction, he thought the term "base metal" an unfortunate one. It was used in contradistinction to the "noble metals"—platinum and its alloys, but it must not be base in its performance. In order to secure a base metal thermo-couple which was going to be stable, a great deal of refinement had to be given to the alloys before they were used. They were base in the sense that they were cheaper, and so a much more mechanically robust thermo-couple could be used, but as much care had to be given as was given originally to the refinement of platinum and its alloys, and produced such a good pyrometer in the hands of Le Chatelier and Sir W. Roberts-Austen. There was one point about the base metal thermo-couple which had to be borne in mind, and that was that it usually oxidised much faster than the noble metal. In the noble metal the chief danger was contamination either by furnace gases and metal vapours in the furnace gases, or from the alloy (perhaps 10 per cent. iridium with platinum) in the platinum wire. With base metal

thermo-couples that difficulty did not arise. Oxidation and the mechanical fracture of the wire appeared to be the usual end of the life of the base metal thermo-couple, and that, in his experience, generally occurred long before the contamination had reached anything detectable within commercial limits. The usual thing which happened with a properly-made base metal thermo-couple was a satisfactory reading for one hour and no reading at all for the next hour. That might be annoying, but on the other hand it saved the danger of a reading which might be out as much as 5 per cent. without giving any other indication of its error—and that did sometimes happen with platinum.

DR. J. A. HARKER agreed with the Chairman as to the debt metallurgists owed to Le Chatelier. It was quite true there was no more modest man who had received less recognition for very important achievements. Passing to the work of Kowalke, one important thing to remember in connection with the base metal thermo-couple, was that possibly some of the sins of such an instrument had been due to the fact that its dimensions were altogether different, in ordinary practical cases, from the wires which metallurgists had formerly been accustomed to use in the way of platinum alloy couples. The criticism applied more strongly if the outer tube happened to be made of a metal which was a good conductor. He believed a lot of the difficulty with regard to certain types of pyrometer was not due to inherent lack of homogeneity in the wires themselves, but very often was due to lack of sufficient immersion to give the true temperature of the part which really mattered. The question of alundum was interesting, but he was afraid the Norton firm had not got over the difficulty of getting the tubes sufficiently gastight. Some time ago that firm announced that they had made a successful experiment in which an enamel could be put on to the tubes which would make them practically serviceable as protectors for porcelain. He hoped they would succeed, but it was a very difficult matter. The author mentioned fused magnesia as a possible tube. He (the speaker) was afraid that that was not the cure-all. Both magnesia bricks and magnesia in almost every state seemed to have a weak place somewhere about 1200°, though above and below that temperature its indications were correct. With regard to the volatility of metals, Sir William Crookes's experiments showed a good deal, but it was not perhaps generally known that some things were volatile even at much lower temperatures. For example, a little silver would be fatal to a resistance thermometer. Supposing a globule of silver was dropped down the porcelain tube of a resistance thermometer, and it was heated for an hour to 700° C., it broke down the whole of the insulation completely.

MR. HENRY C. JENKINS remarked that pyrometers were comparatively recent inventions. He remembered, as late as 1894, Sir William Roberts-Austen going with a party down to Woolwich Arsenal where they were shown one of their prize possessions which was then being used in connection with gun forgings. The party were shown the "prize" with a good deal of pardonable pride and were asked to calibrate it. The result showed it was about 100° or 150° out of true! That did not matter much at the time, because then people were measuring temperatures by "Joe's" method, and the instrument was of course being used to repeat certain readings. Still, that result made the Arsenal people look rather sick, but they went on unabashed. One was glad to hear that the United States Bureau of Standards was doing such good work. The Geological Survey of that country also had done a great deal, especially Mr. Karl Barée, who, in the eighties, investigated the platinum alloys so thoroughly that it made metallurgists feel that they could rely on those alloys with a good deal of certainty. One point with regard to Kowalke's work was that it was very difficult to make alloys like constantan absolutely uniform. He thought some of the results of Kowalke were really due to his having had wires which were not absolutely uniform in texture. A very small difference in composition with those alloys would very much alter the E.M.F. obtained from those thermo-couples. A slight want of uniformity would account for a good deal if one was not careful to heat one's piece to exactly the same place. He had been much interested in the reference to Mr. Bidwell's work with the carbon graphite junctions. It so happened that in the Royal Mint laboratories, about 1894, he (the speaker) had actually tried two carbons of different materials in order to get thermo-junctions from them. The results were not very favourable, and it was not thought worth while to publish them; but even a piece of coke and a piece of stick charcoal would give a very decent thermo-couple. It could indicate temperature up to about 3000° C., but it was found there was a neutral point at a very inconvenient position in the scale, and that caused him to drop any further work in connection with it. The question of the porosity of the sheaths was very important. A little metallic vapour was fatal to any accurate reading. One might as well not only give up the experiment, but throw the wires away at the same time. With regard to the issue of materials which would give fixed melting-points, he was afraid not much good would be done except with pure materials. Anything like silicate was quite useless. The melting-points were quite indefinite and the cooling-points somewhat difficult to see. There was a very wide field for radiation pyrometry, but he was afraid there was always a difficulty in connection with that of very often looking at a different thing from that of which one was trying to measure the temperature. For instance, the surface of a ladle of steel was a very different thing indeed from what was inside it.

Mr. William F. Beardshaw said, with regard to the Chairman's reference to "Joe," it was quite remarkable how accurately men could gauge temperatures without the aid of any instrument. Although his firm had three or four different pyrometers ready for use, it was not always found necessary to use them, because men who were accustomed to handling steel every day could tell the temperature to within 20 degrees without their aid.

The Author, in reply, said he quite agreed with the Chairman that metallurgists owed almost everything with regard to modern pyrometry to Le Chatelier. He also agreed with Sir Robert with reference to the use of the Fahrenheit scale. He had really prepared his diagram in Fahrenheit for the benefit of those who could not think in degrees Centigrade. He believed it was the fact that in many departments in Woolwich Arsenal at the present time the degree Centigrade was not recognised. With regard to the term "base metal," he had tried for a long time to discontinue the phrase and use in its stead "cheap metal." Gradually, however, custom became too strong for him, and he had had to revert to "base metal" because everybody else used it. He was indebted to Dr. Harker for his remarks about the magnesia tubes. Very frequently one thought a thing was going to turn out very good, and then one found some little defect which had not been anticipated, and it did not come up to expectations. He did hope, even if magnesia was not a satisfactory sheath, somebody at some time would devise a good non-permeable sheath for pyrometers which would stand a temperature in the neighbourhood of 2000° C. Speaking within practical limits, the more fragile the pyrometer, and the less material there was about it, the more accurate it was likely to be, but then there were mechanical limitations which had to be provided for There was no doubt that some of the pyrometers in use were absurdly strong—far stronger than was necessary, and the strength was put in at the expense of accuracy. With regard to the carbon graphite junctions, one point in their favour was that artificial graphite could now be obtained of any required size. There were rods on the table in front of him which illustrated that. Finally, he would like to make one more remark with regard to the possibility of a liquid element in a resistance pyrometer. Dr. Northrup conducted his measurement on the resistance of molten metals by having molybdenum terminals dipped in copper. In the work that gentleman carried out, the liquid was between two of those molybdenum terminals, and the results were of a very good order of accuracy, to some fraction of 1 per cent. But whether a practical liquid element could be made out for a furnace was a matter which, for the present at any rate, he preferred to leave to the instrument-maker.

On the motion of the Chairman a vote of thanks was accorded to the author for his interesting and instructive paper.

SUBMARINE SIGNALLING.

A recent number of *Engineering* (April 16th) contains an interesting article on recent advances in submarine signalling, founded on two papers read by Mr. J. B. Millet and by Commander F. L. Sawyer before the Society of Naval Architects and Marine Engineers at the New York meeting last December. It will be remembered that Mr. Millet introduced the invention to this country in the paper which he read here in May, 1906.*

According to the writer in *Engineering*, the whole recent development has been in the direction of furnishing ships with warning signals from coast bells, and little practical advance has been made in the way of fitting ships with means of signalling from one vessel to another in a fog. It appears that this extension of a very valuable invention has not as yet passed beyond the experimental stage.

Apparatus has, however, been constructed, and a brief description of it will be found in *Engineering*, by which ships approaching one another at full speed have been able to locate one another's position at distances of from two to three miles, while distinct signals have been received over a distance as great as ten nautical miles. It is suggested that by one or other of the systems described—one of which is the invention of Professor Fessenden, and the other of Mr. H. Christian Berger—a submarine could be fitted up so that she would be able, by means of a comparison of the sounds heard in two sensitive receivers, one on each side, to stalk a moving battleship, and with practice to ascertain her position with fair accuracy. In the same way a destroyer might discover and stalk a submarine. These, however, appear to be matters for further investigation and future development.

BUNDER ABBAS AND ITS TRADE.

The future of Bunder Abbas, one of the chief ports of the Persian Gulf, is very interesting, especially in view of the prospective development of Basra through the transfer of the vilayet and city of that still more important emporium and locality from Turkey to Great Britain. Bunder Abbas consists of a straggling collection of houses built of sun-dried bricks, which stretches along the beach for about a mile and a half, and gives access to the various routes to the interior. These routes give the town its real importance, and thereon its prosperity and trade very largely depend. Only a very small proportion of the goods landed at Bunder Abbas is consumed in the place itself; the bulk is forwarded to Yezd, Kerman, and other distributing centres in the interior, the port being thus the gate of South-Eastern Persia through which goods pass on their way to and from the interior. The official language is Persian, and the better

* See *Journal*, May 4th, 1906, Vol. LIV. p. 642.

classes can all speak and write it correctly. It is also interesting to know that there is an increasing tendency to learn English, and instruction in our language is now given in the local school by a native of India. Many of the rising generation, therefore, should possess a practical knowledge of English in a few years' time. The roadstead is an open one and very shallow, but, on account of the islands in front, is very sheltered. Port in the European acceptation of the word there is none; there are neither wharves nor lights, and, owing to the shallowness of the water, ships have to anchor about one and a half to two miles out. Goods, having been lightered —a process which is very laborious—and passed through the customs, have to be sent by the consignee to the interior, the means of transport being camels, donkeys, and mules, the last being scarce and expensive. Kerman is the chief centre to which goods are sent, and for camels the journey takes thirty-five days. The roads are extremely rough, but during 1913–14 their condition has shown a marked improvement, and only one minor robbery has been reported. The trade is extremely responsive to any improvement in the condition of the trade routes and cheaper telegraphic communication, and there seems every likelihood of a greater volume of trade next year. Sugar and piece goods comprise 63 per cent. of the total imports. During 1913–14 imports of German beer largely exceeded those of British beer, but the year just passed will doubtless have shown a reversed condition of affairs. With regard to cotton piece goods, those imported from India seem to be steadily gaining in popularity at the expense of those from the United Kingdom. Carpets form 53 per cent. of the total exports, and show a steady increase. The manufacture of carpets is the sole industry in these parts, and it is difficult to imagine a better means of payment for goods imported from abroad in the case of a country possessing no means of transport except beasts of burden.

EMPIRE NOTES.

Australian Transcontinental Railway Extension.—The Prime Minister of Australia, recognising the need for a strategic transcontinental railway, as suggested by Lord Kitchener during his visit to Australia a few years ago, is anxious that there should be a cross-country continuation of the line now being constructed between Kalgoorlie (Western Australia) and Port Augusta (South Australia), in order to avoid the risks attending the use of the present trunk lines, which are often close to the coast. In the course of a statement on the subject, Mr. Fisher laid great stress upon the time-saving possibilities of the proposed extension, which would run from Port Augusta to Brisbane through South Australia to the Murray Valley, then between the Darling and the Lachlan Rivers in a north-easterly direction to the neighbourhood of the Moree in New South Wales. Some striking alterations in the distances between the various State capitals, said Mr. Fisher, would result from the construction of the railway. On the completion of the Kalgoorlie to Port Augusta section of the transcontinental railway, Perth would be connected by an almost straight line through to Sydney, the existing railway between Condobolin and Sydney being probably made part of the route. Melbourne also could be brought into much closer touch with Brisbane. It is estimated that with through railway communication between Brisbane and Perth the journey could be made in sixty hours less than by the completed inter-State system, at present being constructed, while the reduction of time between Sydney and Perth would be about forty hours, and between Adelaide and Brisbane by something like thirty hours. Figures like these, said Mr. Fisher, appealed strongly to the military authorities, who were looking at the question from the point of view of defence; but the commercial community all over the Commonwealth would be interested quite as much in any practicable scheme which would bring the capitals closer together. A preliminary survey is being arranged of the proposed route from Port Augusta to Brisbane as outlined by the Prime Minister. The estimated cost of the extension would be about £6,000,000.

Railway Development in British Columbia.—According to Sir Richard McBride, the Premier of British Columbia, who is at present on a visit to this country, railway development, notwithstanding the financial stringency of the times, has been progressing at a splendid rate in that province. Within the past year the Grand Trunk Pacific Railway has completed its transcontinental line to Prince Rupert, and has now opened a through service between that point and Winnipeg. The region traversed by that system in British Columbia was some 600 miles to the north of the section through which the Canadian Pacific Railway passed. In the south, the Canadian Northern line had completed its transcontinental section to tidewater on the Pacific coast, and by midsummer a through service would be inaugurated. This would not only give the province a third transcontinental service, but would also place British Columbia in close touch with many towns on the Canadian Northern system, which would become purchasers of the fruit, timber, and fish produced by the coast province. On Vancouver Island the Canadian Northern has proceeded well with the work of construction between Patricia Bay and Alberni, and negotiations are now in progress between the Government and the company, in order that a train service may

be inaugurated in the near future. The principal lines undertaken by the Canadian Pacific Railway were the Kootenay Central, linking up the main line at Golden with the Crow's Nest route near Steele, traversing the splendid Kootenay and Columbia Valleys, and the Kettle Valley Railway from Midway to Hope, which would practically give the Canadian Pacific a second transcontinental line to tide-water, in addition to opening up the Nicola, Okanagan and Boundary districts. In regard to the Pacific Great Eastern Railway, it was hoped that by the end of the year connection would be made between Fort George on the Grand Trunk Pacific main line and Vancouver. An extension of this line in a northerly direction from Fort George to the Peace River was projected, which would bring that important district within 800 miles by rail of Vancouver. From the Peace River, through Northern British Columbia, the Yukon and Alaska, another link of 1,200 miles would give direct railway communication between the Northern Pacific country and the entire south. Although the proposal that the United States and Canadian Governments should co-operate to push forward this project had been temporarily shelved, Sir Richard hoped that the scheme would be taken up in the near future and pushed to completion, by which fresh and profitable opportunities would be given to hundreds of thousands of enterprising people to make new settlements.

Lake Steamers for the Atlantic Trade.—In order to cope with the enormous amount of tonnage to be handled from Canadian ports this spring, it is reported that twenty-six lake boats have been chartered for Atlantic and Gulf of St. Lawrence business. For the most part, these vessels are being chartered on time charters, that is, for a period of six or seven months, so that they may return, in many cases, in time to handle the anticipated record wheat crop in the autumn. Some of the vessels, however, have been chartered with an option on their services for a year. The need of this arrangement is evident from the fact that, in addition to the usual ocean traffic, including wheat, dairy products, and manufactured goods, there will be large consignments to the War Office. The chief consignments of this kind will consist of shrapnel shell and other munitions now being made in Canada for the British Government. Grain is, however, expected to move out in heavy volume in the first six or seven weeks of navigation. The ocean rates seem to be advancing every day, according to the statement of a high official in one of the leading transportation companies at Halifax, Nova Scotia, and the owners of some ships are holding out for still higher prices. But, without the ocean business, it is affirmed, the outlook for the navigation companies would not be of the brightest as, apart from the grain to be moved from the head of the lakes immediately after the opening of navigation, the demand for inland tonnage has, so far, not been of a record-breaking character.

Flax Prospects in Canada.—The announcement of the formation of a Canadian Flax Association is of particular interest just now, when supplies of flax have been practically cut off owing to the war. There seems to be no doubt that Canada should be able to meet the demand which is sure to arise in linen centres for high-grade fibre, owing to the threatened scarcity. The climatic conditions of the soil of the Western Provinces of the Dominion are ideal for the growing of the plant, from the fibre of which the world's linen is made. At present, something like one million tons of flax straw are burnt in Canada every year, simply because it has not been raised in marketable form. In 1913, the area in flax in the west amounted to one and a half million acres, and it is estimated that, under careful cultivation, this could be made to yield at least two million tons of fine flax straw. Experts appointed by the Dominion Government, and others who have investigated the conditions of the west, agree that there is much land open for homesteading, along the line of the Canadian Northern Railway, which is ideal for flax-growing, and that there is no reason why the finest flax straw in the world should not be raised in these districts. Proper methods would, of course, have to be adopted; but these would not necessitate any disorganisation of present farming operations. It could not be expected that the finest material could be raised the first year; but, apart from the fact that the flax seed would yield sufficient to put the homesteader on his feet, there is an important advantage to be gained in planting flax the first year, as it is one of the best crops for breaking up the soil and for freeing certain natural fertilisers that are latent in virgin soil, which may be too rich at first to grow wheat to advantage.

Khaki Dyewoods from the West Indies and South Africa.—Recognising the urgency of the need of increasing the supply of yellow dyes for the manufacture of khaki cloth, the directors of the Imperial Institute have been in communication with Jamaica, British Honduras, and South Africa, for the obtaining of substitutes, obtainable from a tree indigenous to Jamaica and British Honduras, and from Cape boxwood. When war broke out, as the circular of the West India Committee showed, there was only a small quantity of cut wood available in the West Indies to meet British demands, as most of the regular supplies were destined for France and the United States. But measures

have now been adopted by the Government of Jamaica to increase purchases from the growers and to stimulate further supplies by bearing the cost of shipment to Kingston. Similar action is being taken in British Honduras, and there is every probability that the largely enhanced quantities thus obtainable will not only benefit the local growers but will also provide the British dyers with the ingredients for their industry, the lack of which, since the outbreak of the war, has been the occasion of considerable anxiety. On the advice of the Institute, trial shipments of boxwood are also being sent from the Cape, to be placed on the London market.

Lahore's Memorial to King Edward.—A memorial to the late King Edward is to be erected in Lahore at a cost of £213,345. It will consist of: (A) A medical college with (1) a new main block with administrative offices, common rooms, library and examination hall, and lecture theatres for senior subjects; (2) a research institute housing the pathology, physiology, and hygiene departments of the college; (3) a cold storage block with judicial and pathological post-mortem theatres; (4) extension of the anatomy and materia medica blocks; (5) a students' hostel to accommodate 150 students. (B) A hospital with (1) a greatly enlarged Mayo Hospital main block, of which the present medical college will form the out-patient department; (2) a much extended septic block; (3) a new tuberculosis block; (4) the conversion of the Lady Lyall Home into an eye, ear, and throat out-patient department; (5) substantial additions to the Albert Victor Hospital; (6) Indian family and private paying wards with their own operating theatre; (7) a new nurses' home; (8) residential quarters for both European and Indian house surgeons; (9) a steam laundry and disinfecting plant and incinerator; (10) a large number of menials' quarters. It is hoped that the new buildings will be completed some time in 1917.

OBITUARY.

George Humphreys-Davies.—Mr. George Humphreys-Davies died at his residence in London on April 15th, after a long illness.

Born in 1848, he practised in London since 1887 as an architect, surveyor and valuer, and he was the founder of the firm of Humphreys-Davies & Co. He was well known throughout the country as one of the leading experts in the valuation of special properties and undertakings, and particularly in connection with the exemption of machinery from rating.

Mr. Humphreys-Davies was joint-author with the late Sir Edward Boyle, Bt., K.C., of "The Principles of Rating," on a third edition of which Mr. Humphreys-Davies had begun to work. He was also the author of many papers read before various technical societies. Among these may be mentioned the "Rating of Coal Mines," read before the Institute of Mining Engineers, and the "Value of Buildings and Machinery as a Lender's Security," read before the Institute of Bankers.

He took a keen interest in social problems, especially those affecting the working-classes. He was the honorary surveyor, and often gave advice to the London Association for the Blind. He devoted much time and thought to lectures, which he gave over a long period to the members of the Plaistow Brotherhood. He was also a Freemason, holding the rank of Grand Officer in his own province of South Wales. He was a devotee of yachting, and a keen collector of china and pictures. A loyal Churchman, he liberally assisted many works of charity, the most remarkable of all his actions being the generosity with which he treated his employees, practically handing over to them his whole business, "in consideration of their long and faithful service."

Mr. Humphreys-Davies joined the Royal Society of Arts in 1908. He was also a member of the Royal Institution, the Royal Society of Literature, Ethological Society, and many other organisations.

Henry Burdett Hederstedt, M.Inst C.E.—Mr. Henry Burdett Hederstedt, whose death took place on April 29th, at his residence, Twyford Lodge, Bickley, Kent, was in his eighty-second year, having been born at Southampton in 1833.

Under his brother-in-law, the late Sir Rowland Macdonald Stephenson, he was sent out to Asiatic Turkey to conduct surveys for proposed railways. He then joined the staff on the construction of the Madras Railways, and afterwards became Chief Engineer of the Oudh and Rohilcund Railway, a position which he filled for about twenty years. He carried out many important works in India, the chief of which was the great Dufferin Bridge over the Ganges at Benares, whereby the Oudh and Rohilcund Railway was connected with the East Indian Railway.

Mr. Hederstedt had been a member of the Royal Society of Arts since 1890.

José Custodio Fernandes do Nascimento.—The Society has lost its oldest member in South America by the death of Dr. J. C. F. do Nascimento, who died in Rio de Janeiro on March 28th. He had been a member of the Society for just fifty years, having been elected in 1865.

Dr. do Nascimento was born at Pernambuco, Brazil, in 1843. He was educated in London, where he studied mechanical engineering. In 1865 he returned to Brazil, and devoted himself to the task of developing the navigation on the River Amazon, designing the first screw-propelled vessel that plied on its waters. He became one of the directors of the large shipbuilding works in Rio

de Janeiro, where many large ships have been repaired, and where others would have been built had not the troubled political state of the country interfered with this industry. Subsequently he was also a director of the repairing shops of the Central Brazil Railway, the most important line in the country.

GENERAL NOTES.

EFFECT OF THE WAR ON THE FOREIGN TRADE OF FRANCE.—The effect of the war on the foreign trade of France is clearly shown by the following statistics lately published by the Minister of Finance. They give the values of the imports and exports of that country during the last five months of last year as compared with the similar period of 1913:—

IMPORTS.

Year.	Francs.	£ Sterling.
1913 . .	3,510,432,000	140,417,280
1914 . .	1,385,274,000	55,410,960
Difference	2,125,158,000	85,006,320

EXPORTS.

Year	Francs.	£ Sterling.
1913 . .	2,969,434,000	118,777,360
1914 . .	994,624,000	39,784,960
Difference	1,974,810,000	78,992,400

This shows a decrease during the first five months of hostilities of:—

Imports— Francs. £
2,125,158,000 (85,006,320) = 59·5 per cent.
Exports—
1,974,810,000 (78,992,400) = 66·5 „

Total . 4,099,968,000 (163,998,720) = 63·2 per cent. on the total foreign trade for the first five months after the outbreak of hostilities.

KELP INDUSTRY IN SCOTLAND.—A leaflet issued by the Board of Agriculture for Scotland says the kelp industry has improved in the last five years, and it would pay crofters and others in districts where the right kind of seaweed is found on the shore. Up to about seventy years ago kelp was made for the soda which was obtained from it. Other and cheaper ways of getting soda were found out, and the price of kelp became lower and lower, so that in many districts the people gave up the making of it. Soon afterwards iodine and potassium begun to be extracted from kelp, and the price rose slightly. There were ups and downs, but, on the whole, the value increased. From 1907 to the early part of 1914 this rise in value became marked. Potash has been obtained almost altogether from Germany, where there are mines of it. Consequently, as long as the war lasts, the only important available source of potash will be kelp, and hence the price of kelp has increased since the war. The consumption of potash is very great. It is the main constituent of several important artificial manures, besides being largely used in manufactures. Also, since iodine is in growing demand in military surgery, its value, too, is likely to become higher; though even during the war the increase is not likely to be so great as in the case of potash, because iodine is obtained from the nitrate fields in Chile as well as from kelp. At the lower value of kelp before the war a crofter in the Hebrides with a horse and cart might expect to get 10s. a day for a full day's work. Often members of the same family work together. Thus a father and two sons in one summer made £30 during the time when they had no work to do on the croft. Just before the war it may be estimated that where the proprietors offered facilities on moderate terms the price which the workers might expect to receive for one ton of kelp was £5 to £5 10s. It is probable that this season at least £1 more per ton may be obtained. To secure this sum the worker will have to gather the proper weed, to dry it, and then burn it. It requires about five tons of dry weed to make one ton of kelp.

THE LABOUR MARKET IN MARCH.—According to a report in the *Board of Trade Labour Gazette* for April, employment in March showed a general improvement, and there was a shortage of male labour in many industries, especially in engineering and shipbuilding, coal-mining and agriculture, and of female labour in some branches of the clothing trade. The trades affected by war contracts continued to be very busy. There was a further improvement in the iron and steel, cotton, linen, jute, lace, silk, bleaching and dyeing, food preparation and pottery trades. There was also some improvement in the furnishing and woodworking trades, and a seasonal advance in the building and brickmaking industries The coal-mining, pig iron, tinplate, and glass trades showed little change. Compared with a year ago, there was a great improvement in all trades affected by war contracts, especially the engineering, shipbuilding, woollen, hosiery, boot, and men's clothing trades. Employment also improved in the iron and steel, building, and woodworking trades. On the other hand, the tinplate, cotton, linen, lace, silk, bleaching and dyeing, pottery, brick and glass trades were considerably below the level of March 1914. The number of days worked by the collieries was about the same as a year ago, but the number of men employed was greatly reduced by enlistments.

THE MADRAS COTTON CROP, 1914-15.—The actual area sown with cotton in the Madras Presidency is 2,355,500 acres, which is 13 per cent. less than last year, but is about 3½ per cent. above the average of the actual areas of the last five years. The area is slightly in deficit in all tracts but chiefly in

"Salems," where the season at sowing time was not favourable. In Tinnevelly, which is always the area last sown in Madras, there were indications at first that the fall in prices of cotton might result in restricted sowings, but especially in the south the rain was so heavy that cumbu failed, and late cotton was sown in its place. Sowings continued even till the end of December, and the final result is that the area sown is very little below the normal. The estimated outturn in the Presidency is 320,365 bales of 400 lbs. each, which exceeds the reported estimated outturn according to the final accounts of last year. There is, however, reason to believe that the reported outturn on the final season and crop report figures for last year was too low. Reports show that the outturn of "Cocanadas" will be up to a normal crop, and those of "Northerns" in Kurnool nearly so. The area under "Westerns" in Bellary and Anantpur has, however, suffered from prolonged drought, and the outturn there will be from 40 per cent. to 50 per cent. in deficit of a normal crop. In "Salems," the outturn in the area sown is expected to be better than last year. In "Tinnevellies" sowings were so late that it is more than usually dangerous to attempt any prophecy, but the crops, though sown late, have on the whole made good progress; and it would seem reasonable to expect there a crop of good quality, but in the extreme south with outturn below the average. The Native States of Banganapalle and Pudukkottai report an area of 28,300 acres, with an estimated outturn of 5,277 bales, bringing the gross total of the Presidency up to 323,642 bales of 400 lbs. each.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 17. ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Dr. D. Sommerville, "Foodstuffs." (Lecture IV.)

Victoria Institute, Central Hall, Westminster, S.W., 4.30 p.m. Rev. Professor A. R. S. Kennedy, "Weights and Measures of the Hebrews."

Geographical Society, Burlington-gardens, W., 3 p.m. Anniversary Meeting.

British Architects, Royal Institute of, 9, Conduit-street, W., 8 p.m. Mr. H. V. Lanchester, "The Evolution of the Architectural Competition."

TUESDAY, MAY 18 ... Statistical Society, Adelphi-terrace, W.C., 5.15 p.m. Mr. S. Rosenbaum, "The Effects of the War on the Overseas Trade of the United Kingdom."

British Constitution Association, at THE ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 10.30 a.m. (Annual Conference.) 1. Presidential Address. 2. M. Yves Guyot, "Economic Lessons of the War."

2 p.m. Sir W. Ramsay, "Lessons of the War—What we have to Learn."

Illuminating Engineering Society, at THE ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 7.30 p.m. 1. Annual General Meeting. 2. Discussion on "Some Points in Connection with the Lighting of Rifle Ranges."

Royal Institution, Albemarle-street, W., 3 p.m. Professor F. Soddy, "Advances in the Study of Radio-Active Bodies." (Lecture II.)

Anthropological Institute, 50, Great Russell-street, W.C., 8.15 p.m. Dr. J. O. Kinnaman, "Who were the Cliff-Dwellers?"

WEDNESDAY, MAY 19...Meteorological Society, 70, Victoria-street, S.W., 4.30 p.m. 1. Dr. H. R. Mill and Mr. H. E. Carter, "The Wet English Winter of 1914-1915." 2. Mr. J. E. Clark, "Report on the Phenological Observations for 1914."

British Constitution Association, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 11 a.m. (Conference continued.) Dr. T. Baty, "The War and International Law."

2. p.m. The President, "The Meaning of Nationality."

Microscopical Society, 20, Hanover-square, W., 8 p.m. Dr. M. Burr, "On the Male Genital Armature of the Dermaptera."

Literature, Royal Society of, 20, Hanover-square, W., 5.15 p.m. Professor W. L. Courtney, "Marlowe and Shakespeare."

THURSDAY, MAY 20...Aeronautical Society, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8.30 p.m. (Wilbur Wright Memorial Lecture.) Professor G. H. Bryan, "The Rigid Dynamics of Circling Flight."

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Chemical Society, Burlington House, W., 8.30 p.m. 1. Mr. P. W. Robertson, "A new method of estimating bromine and chlorine in organic compounds." 2. Mr. B. Campbell, "Contributions to the study of acenaphthylene and its derivatives."

Royal Institution, Albemarle-street, W., 3 p.m. Professor V. H. Blackman, "The Movements and Activities of Plants." (Lecture II.)

Historical Society, 22, Russell-square, W.C., 5 p.m. Rev. P. H. Ditchfield, "The Errors of Macaulay in his Estimation of the Squires and Parsons of the Seventeenth Century."

Concrete Institute, 296, Vauxhall Bridge-road, S.W., 7.30 p.m. Mr. E. A. W. Phillips, "Lime Concrete in the East."

Royal Society of Medicine, 1, Wimpole-street, W., 4.30 p.m. Section of Dermatology.

5 p.m. (Annual Meeting.) Discussion on "The Pemphigoid Eruptions," to be opened by Dr. J. M. H. MacLeod.

Mining and Metallurgy, Institution of, at the Geological Society, Burlington House, W., 8 p.m.

FRIDAY, MAY 21...Royal Institution, Albemarle-street, W., 9 p.m. Mr. E. H. Allen, "Beauty, Design, and Purpose in the Foraminifera."

Royal Historical Society, 22, Russell-square, W.C., 8.30 p.m. The Hon. J. W. Fortescue, "The Last Great War (1795-1814) and the Present."

SATURDAY, MAY 22...Royal Institution, Albemarle-street, W., 3 p.m. Dr. M. O. Forster, "Colouring Matters of the Organic World." (Lecture I.)

Journals Wanted.—One of the departments of University College, London, is anxious to be supplied with a second copy of the Society's *Journal*, in addition to the copy presented by the Society to the College Library. Any Fellow who does not preserve his *Journal*, and would therefore be willing to give it away after he has done with it, would confer a favour on the Secretary of the Society if he would communicate with him. A gift of any fairly complete sets of the *Journal* for the past two years would also be appreciated.

Journal of the Royal Society of Arts.

No. 3,261. VOL. LXIII.

FRIDAY, MAY 21, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

THE SOCIETY'S ALBERT MEDAL.

The Albert Medal of the Society for the current year has been awarded by the Council, with the approval of the President, H.R.H. the Duke of Connaught and Strathearn, K.G., to Professor Sir Joseph John Thomson, O.M., D.Sc., LL.D., F.R.S., for his researches in physics and chemistry, and their application to the advancement of Arts, Manufactures, and Commerce.

CANTOR LECTURES.

On Monday evening, May 17th, Dr. David Sommerville, B.A., M.Sc., M.R.C.P., D.P.H., Assistant Professor of Hygiene and Public Health, University of London, King's College, delivered the fourth and final lecture of his course on "Foodstuffs."

On the motion of the Chairman, a vote of thanks was accorded to Dr. Sommerville for his interesting course.

The lectures will be published in the *Journal* during the summer recess.

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

A meeting of the Colonial Section was held on Tuesday, May 4th, 1915; The Hon. Sir George Perley, K.C.M.G., member of the Canadian Government, in the chair.

The Chairman, in opening the meeting, desired in the first place to say how happy he was to take the chair at a meeting of the old and influential Royal Society of Arts. It was an honour and a privilege which he much appreciated, not only personally but because it was an honour to Canada, which he represented in London. The author of the paper to be read at the meeting was the founder and proprietor of *The Paper Maker*, and had long been a well-known figure in paper and pulp trade circles, not only in this country but on the Continent and across the Atlantic. For the past thirty years he had devoted most of his time to investigating paper-making and allied subjects, of which raw materials formed a very important part. The author had visited every country in the world where paper-making was carried on; he had been in Canada and the United States many times, and had travelled to every territory where raw materials for the industry were found to investigate the possibility and the use of new fibres for paper-making. The author had taken great personal interest in all practical ideas relating to the discovery of new fibres, and had spent a great deal of time in investigating the claims of the various materials brought to his notice. He was therefore specially well informed about the subject on which he was to read the paper. Ten years ago the author read a paper before the Society on the use of wood pulp for paper-making, on which occasion the late Lord Strathcona presided. He (the Chairman) desired to take the present opportunity of saying how much they missed Lord Strathcona and his wise counsel, which was at the service of Canada for so many years, and which was needed so much during the present critical times.

The paper read was—

THE EMPIRE'S RESOURCES IN PAPER-MAKING MATERIALS.

By S. Chas. Phillips, M.S.C.I.

It may be within your knowledge that in the year 1905 I had the honour of presenting in this room a paper on "The Use of Wood Pulp for Paper-Making." That paper was devoted exclusively to wood pulp considered particularly from the paper-makers' point of view, and on that occasion we were honoured by the presence in the chair of the late Lord Strathcona who, I happen to know, took a very close personal interest in the wonderful possibilities of Canada as a field for the paper-makers' enterprise. It is, I venture to say, extremely fitting

also that Sir George Perley is with us this afternoon, because he has also proved in many ways that he fully realises how the present and future interests of Canada are largely bound up with paper-making and paper-makers' requirements, and it is a very interesting fact that in the consideration of "The Empire's Resources in Paper-Making Materials" Canada stands out almost by itself.

I have taken a very close interest in this wide subject during the past thirty years and have travelled frequently and extensively in many countries, including many parts of the British Empire in connection with my studies of wood and other fibres suitable for paper-making purposes. In fact, I have devoted the major portion of my life in all parts of the world in investigating the many processes employed in connection with my text and watching their development.

I need scarcely tell you that cheap papers are now produced mainly from wood pulp, and, although we in this country are still dependent to a large extent on Scandinavia for our supplies, Canada as a wood pulp country has come to the front with great rapidity. It is very gratifying to know that Canada at the present time supplies the world with 320,000 tons, approximately, of paper-making materials in the shape of wood or wood pulp, chemical or mechanical.

It is no secret that America in recent years has been turning, I am tempted to say, with a feeling almost approaching anxiety, to Canada for wood pulp for the purposes of paper-making, and, to the uninitiated, it is almost startling to know that one undertaking in the Province of Quebec has a capacity for sending out, roughly, 100,000 tons of ground wood per annum, a very considerable proportion of which is consumed in England, very largely by paper-mills on the Thames.

Time does not permit of my going into very precise details as to the materials used in a modern paper-mill, but although the paper-maker to-day relies chiefly on rags, wood, or esparto, it may be necessary to refer in a general way to quite a number of other fibres which have been in years gone by, and are even to-day being experimented upon with more or less success. For the purpose of this paper we may consider rags, wood, bamboo, and, to a limited extent, other fibres, also peat, as covering for practical purposes the materials utilised to-day and produced within the Empire on a commercial basis for paper-making.

I may also say that this paper has not been prepared for the purpose of educating the paper-maker, neither do I claim to be able to teach some of the gentlemen I see present anything regarding what I may term the higher botany. I am merely endeavouring to collate certain facts, which, I hope, may be helpful to those who are seriously considering the application of certain possible fibres which may be of practical service to paper-makers in the future.

I strongly advise any one interested in this subject to pay a visit to the Museum at the Royal Botanic Gardens, Kew; and I may here say that by the kind courtesy of Mr. J. Masters Hillier, Keeper of Museums, I was recently permitted to inspect and examine the extremely interesting specimens of direct interest to paper-makers there to be found. Like most people who have gone pretty deeply into the subject of the consideration of fibres suitable for paper-making, I have found that many of the so-called new fibres have been experimented upon again and again, and many of the old reports dealing in detail with investigations of half a century ago, and even prior to that date, deal specifically with kindred fibres which are constantly cropping up, and even to-day are being in certain quarters considered and investigated as novelties. Another important fact which should not be lost sight of is quite common in the experience of investigators—that of jumping to the conclusion that certain fibres, which in handling and appearance have a close resemblance, may be of equal utility when submitted for practical purposes to the paper-maker. Investigations show that, as a matter of fact, many of these growths, apparently so much alike, are totally dissimilar in regard to yield and paper-making qualities. Mr. Hillier incidentally mentioned that this experience is not confined to paper-making and paper-making fibres, but is pretty general in regard to other trades where enterprising people are constantly on the look out for new fibres of practical utility. The Museum at Kew devoted to economic botany affords convincing evidence of the amount of research devoted to the subject now under consideration in bygone years, and the name of Mr. Routledge is constantly recurring, and most of us, I think, will agree that it was largely due to Mr. Routledge's experiments and persistency that we to-day, as paper-makers, hold the strong position we do in esparto papers.

Mr. Routledge satisfied himself that the true esparto had many advantages over its so-called rivals, but with the loyal co-operation of the

then Director of the Gardens at Kew, and other gentlemen whose help was invaluable, Mr. Routledge investigated the properties from the paper-makers' standpoint of quite a number of samples, which included bamboo, baobab, etc.

In regard to baobab, Professor Hübner, in the year 1903, in his Cantor Lectures, had many interesting things to say; and Mr. Routledge appears to have made exhaustive experiments with baobab (otherwise maputa cloth), which it has been found is capable of yielding paper very much after the style of what we know as Japanese papers, producing a number of specimens which he described as "fair paper." He also investigated and experimented with heliconia, bihai, *Lepidosperma gladiatum*, which it was found did not offer much promise; also *Phragmites communis*, the well-known British reed which at one time was described as affording great possibilities, which, however, were not realised.

Then tests were made with majorca and *Uniola virgata*, which fibre was described as possibly one which might, if necessity arose, be "something to fall back upon," and, although not as good as esparto, either in yield or quality, was useful.

In the years 1876–7 Dr. King, Superintendent of the Royal Botanic Gardens in Calcutta, supervised a large number of experiments which covered a very large field, and, briefly, his findings were that the Californian cactus gave indifferent results. The *Calotropis gigantea* provided two fibres, one of which was considered likely to be of value to paper-makers, but actual tests did not apparently come up to expectation. Caraguata was also examined without very definite results, but a particularly interesting fibre was the *Cavanillesia platinifolia*, a growth allied to the mallow. The examiners reported regarding this: "It pulps extremely well and bleaches readily, and is capable of being made into strong opaque white paper of fine quality."

Opontia, a kind of prickly pear, seems to have occupied a lot of attention at one time, but was found to be of no economical value.

In the year 1878, the Rev. C. Parish wrote a number of contributions as to the possibilities of bamboo; and he considered that one of the principal virtues of bamboo, from the paper-makers' standpoint, was its rapid growth, and the fact that it could be cut annually. Thus does history repeat itself.

A particularly interesting fibre is that of *Broussonetia papyrifera*, of the mulberry tree order, which, incidentally, provides the famous tapa cloth, a cloth that serves a large variety of purposes in the countries where it is grown. Mr. Routledge was very enthusiastic regarding what we may describe as the tapa cloth fibre, and he reported upon it that "it is nearly, if not quite, the best fibre I have ever seen, and I must admit it is even superior to bamboo. It requires very little in the way of chemical treatment, and gives the excellent yield of 62·5 per cent. in the grey, *i.e.*, merely boiled, condition, and 58 per cent. bleached."

Very encouraging results were at one time obtained from the guadua (gigantic bamboo), and considerable attention has also been devoted to *Molinia cœrulea*, otherwise rye straw; and in the year 1880 a report was presented to the India Office on the commercial value of muddar. Probably many present are aware, also, that the report of L. Liotard provides a most valuable contribution regarding the materials in India suitable for the production of paper. This report is very exhaustive, and, if time permitted, I would like to have presented some of the very interesting details given in L. Liotard's publication. The investigators seem to agree that none of the fibres experimented upon appear to compete seriously with esparto, particularly as regards supplying British paper-makers, for reasons well understood.

I may here mention that, at this moment, one of our leading paper-making experts is making experiments with the *Nipa fruticans*, otherwise known as the nipa palm, and I have here some laboratory-made specimens, made in London, from this fibre quite recently. Some of the specimens, of what may be described as fibre boards in a very rough and unfinished condition, are distinctly good in the essential properties of value in boards of this class; and possibly we may hear more of the nipa palm, providing it can be collected and partly prepared in countries where it abounds, and can be delivered in Europe in quantities and of a quality makers of strong boards and strong packing papers might seriously entertain.

Whilst at the Museum at Kew, I learned the extremely interesting fact that nuts of the *Nipa fruticans*, and of allied plants, have been found in considerable quantities in the tertiary remains unearthed from time to time in the Isle of Sheppey, at the mouth of the Thames. That this plant should have grown here at some very remote period provides food for thought and reflection.

A special article could be devoted to lallang grasses alone (*Imperata arundinacea*), which one

authority described as a pestilent weed which, when once allowed to invade a plantation, can only be eradicated at enormous expense. These grasses have been very closely and adequately experimented upon at the Aynsome Laboratories, and Messrs. John Dickinson and Company made experiments on them in the year 1905; but apparently had only an opportunity of testing a block of dried fibre, which gave results intermediate between Spanish esparto and good straw fibre.

Great Britain.

This country is not rich in paper-making fibres, but it is interesting to recall that two or three years ago attention was drawn to the possibilities of marram (or beach) grass (*Ammophila arenaria*), which is grown on the sandhills around our shores, as well as on the Continent, in temperate North America, Northern Africa, and Australia. It is one of the most valuable of the grasses adapted to binding drifting sands; but, according to Spon, its fibre is used for paper-making, matting, and tie bands, and is employed as thatch material. To what extent it has ever been used in the production of paper I am not able to say; but there is the authority of Beadle and Stevens, who some time ago examined a consignment of marram grass from the Norfolk sandhills, for stating that it was found to produce "a soft pulp with a short tear, which more nearly resembles in general feel and external appearance the pulp produced from esparto or chemical aspen wood pulp." The grass was boiled under pressure, without passing through crushing rollers, and then bleached, the result being that the yield of unbleached fibres on the original green weight of the stem was 17·7 per cent., and on the dry weight 31·4 per cent., the yield of bleached fibres being 13·1 and 25 per cent. respectively. Messrs. Beadle and Stevens suggested that, should marram grass be deemed of sufficient importance as a paper-making material, its cultivation could be extended over considerable tracts of sandy country bordering the coast in various parts of the British Isles.

Quite recently serious suggestions were put forward in the House of Commons with a view to afforestation on a large and scientific scale in the United Kingdom, particularly in Scotland, and it was suggested that a great deal of timber required for paper-making in this country could be produced at home. I believe some gentlemen advocated this idea as a remedy for unemployment, but I do not think there is any likelihood of timber being grown at a profit or with any considerable success, especially for the purposes of producing pulp.

Not long ago, Mr. T. Parker Smith, the managing director of one of our leading paper-making concerns, presented an interesting paper on the subject before the British Paper-Makers' Association, and the facts and figures he presented were very interesting. Personally I do not see much prospect of timber-growing in Great Britain as a sound commercial proposition considered from the paper-makers' standpoint.

It may be within the knowledge of most of you that for a number of years past experiments have been made, with more or less success, with a view to the utilisation of peat as a raw material for paper and boards. Peat is said to be used successfully in the making of wrapping papers in America; but the experiences of paper-makers who have experimented with peat in Great Britain and Ireland have been unfortunate, and I can call to mind at least three ventures of this character which have ended disastrously for the shareholders and creditors. Numerous patents have been taken out for the utilisation of peat in paper-making, and one inventor claims that the oily bodies contained in the peat make paper impermeable to the attacks of insects, rendering furs, etc., wrapped in it safe from moths and mice.

It has been argued that as there are at least 2,800,000 acres of peat in Ireland, the beds in places being 15 ft. in depth, the making of peat paper might become an important Irish industry. Not long ago a company was formed for this particular purpose, and, so far as I am aware, it has gone out of existence. Patents have also been taken out for the forming of paper or board from half-stuff, in which peat played an important part, and in Sweden a factory has been built for the manufacture of board and so-called kraft paper from peat, although, personally, I doubt whether anything of the nature of kraft paper could successfully be made from peat. Attempts have also been made to produce blotting-paper from peat, and at one time there was an undertaking near Athy, co. Kildare, to put these ideas into operation. A well-known Lancashire paper-making firm has also devoted considerable time and trouble to discovering how far peat might be successfully used as loading material in brown papers of various kinds, but these attempts have only met with qualified success.

It has been stated by an authority that peat

is in appearance very misleading, not only to the eye of the layman, but also to the expert, and that peat is generally found intermixed with numerous other fibres and a good proportion of undesirable matter, and it has been computed that 100 tons of bog land might yield 8 tons of solid matter, and that this 8 tons of solid matter would contain at the most 2 tons of peat fibre. The waste involved directly and indirectly has proved a terrible disappointment to those who have entered into the utilisation of peat with enthusiasm. In the year 1912 a gentleman well known in the paper trade of this country observed that the only successful employment of peat to his knowledge in the paper trade was in mills where about 5 per cent. of peat was added as a colouring agent and partly as a filler, and it does appear that there are very serious practical drawbacks in regard to the successful employment of peat for paper-making.

In Canada the Dominion Government also recently caused investigations of peat to be made, and special attention was paid to the consideration of peat as a paper-making material. It was pointed out that in the Museum of the Swedish Peat Society will be found a considerable collection of peat paper samples from different places, and these include specimens of paper and board said to have been made from Irish peat. It was eventually stated that: "Scientific men in the paper industry do not seem to have had very much confidence in the result of these experiments in regard to peat as a paper-making material, and this lack of confidence was very pointed." It may be fairly stated that the consistency of peat is such that it cannot be expected to make strong and durable paper without the employment of complicated and extensive machinery necessary for the cleaning, bleaching, and dyeing of the peat, and what is of even more importance is the fact that the finished article leaves a great deal to be desired, and can scarcely compete with other materials now on the market.

I may add that, personally, I am rather sorry to have to arrive at this conclusion, as I have purchased my experience rather dearly, and certainly some of our most eminent paper-makers and chemists have been disappointed in regard to the possibilities of peat.

Canada.

That the Dominion of Canada in its vast forest areas possesses an enormous source of wealth with potentialities which as yet are not fully realised may be gathered from the fact that the latest estimates place the total area of land covered by timber at anything between 500 and 600 million acres, of which about half are covered with timber of commercial utility. In 1912 the estimated value of Canada's forests products amounted to the enormous sum of $182,300,000, or nearly £38,000,000, and in view of the annually increasing development in the lumber and timber industries it may be safely said that to-day the figures would reach something like $200,000,000, or about £41,700,000. It is, too, encouraging to note that the Dominion and Provincial Governments, appreciating the importance and the necessity of husbanding the timber resources of Canada, have during the past fourteen years greatly increased its forest reserves, the total area of which has grown from 7,413,760 acres in 1901 to 152,833,955 acres in 1914, measures being also taken, especially by the education and training of forestry experts, to bring the forest areas of the country under more scientific and remunerative management.

Of fifteen groups of kinds of industries in Canada, that of "Timber and Lumber and Re-Manufactures" is easily first when judged by the capital invested, number of employees, and the amount of wages paid, and it is interesting to note that towards this pre-eminence the production of pulp wood for paper-making purposes largely contributes, its value so recently as 1912 being estimated at $12,000,000. Spruce is, of course, the principal wood used in the manufacture of wood pulp in Canada as elsewhere, but balsam fir is also being increasingly used; while hemlock and jack pine have latterly been employed for the same purpose though to a smaller extent. Statistics published in the "Canada Year Book for 1913" show that in that year the following quantities of spruce and other woods were used in the manufacture of pulps: Spruce, 754,858 cords of the value of $5,104,221; balsam fir, 283,292 cords ($1,806,911); hemlock, 47,360 cords ($201,480); poplar, 4,141 cords ($29,081); and jack pine, 19,383 cords ($101,675)—making a total of 1,109,034 cords of the value of $7,243,368. Of this over 600,000 cords, were converted into mechanical pulp, 367,105 cords into sulphite, 136,569 cords into sulphate, and 5,144 cords into soda pulp.

Only yesterday I was fortunate enough to receive from Mr. R. H. Campbell, through the Forestry Branch of the Office of the Commissioner of Commerce, Ottawa, a copy of the statistics for 1914. These show that the quantity of pulp

wood cut in Canada last year amounted to 1,222,527 cords, of a total value of $8,068,184. The cut of spruce was 834,538 cords, of the value of $5,584,242 ; balsam fir, 314,183 cords ($2,067,434) ; hemlock, 45,246 cords ($254,576) ; jack pine, 24,715 cords ($135,762); poplar, 3,845 cords ($21,170). Of the total cut of 1,222,527 cords 52·6 per cent. was converted into mechanical pulp, 33·1 per cent. sulphite pulp, 14 per cent. sulphate, and 0·3 soda pulp. It is noteworthy that while the cut in Quebec and Ontario has shown some increase, those in British Columbia, New Brunswick, and Nova Scotia have decreased, the figures for the five Provinces being Quebec 636,469 cords ; Ontario, 445,902 cords ; British Columbia, 80,013 cords ; New Brunswick, 49,339 cords ; Nova Scotia, 10,337 cords.

The ever-increasing drain upon the forest resources of Canada and the tremendous losses sustained by fire give rise from time to time to anxiety as to the future, but the general opinion —endorsed from time to time by public men— seems to be that the great northern forests of the Dominion are practically exhaustless, and "will afford an abundant supply of timber for all future time," which will be amply sufficient, not only to meet Canada's own needs, but also the increased demands of the United States, and afford a surplus for export to this and other countries. Some time ago, however, Dr. F. D. Adams, Dean of the Faculty of Applied Science at McGill University, in the course of an address before the Royal Society of Canada, made the following significant statement :—

"A careful study of the question by the Dominion shows that so far from being exhaustless, the reserves of merchantable soft timber in the forests of Canada are only between one-quarter and one-fifth of that remaining in the forests of the United States. Of these reserves in Canada, about one-half is in the old provinces of Eastern Canada and the other half in British Columbia. The evidence goes to show that at the present rate of cutting the supply of timber will, within a comparatively few years, be sufficient only for the needs of the Dominion itself, leaving no surplus for export.

"It must be borne in mind that, while a large part of Canada is covered with forest, much of this is a woodland country rather than a country covered with a forest which produces considerable supplies of merchantable timber. Furthermore, the practice which has been followed of cutting out the valuable kinds of timber has left the successively poorer and inferior species of trees—'tree weeds' as they have been called—to multiply without restraint, and thus the forest gradually changes its character and deteriorates in value. Moreover, the rivers draining the northern forest flow down to Hudson Bay, so that the logs if floated down the streams would reach that body of the water instead of the St. Lawrence. With the approaching exhaustion of the reserves of standing timber, there has sprung up within the past few years a demand for pulp wood, to supply which the younger and smaller trees are taken and ground up for the manufacture of paper. Fortunately this is not necessarily so fatal to the continued existence of our forests as might be supposed, for the younger trees, if properly cared for, grow in a relatively few years to the size required for pulp wood. Thus, if the limits over which a company cuts its supplies are large and properly cared for, they can be made to produce a continuous supply of wood for the pulp-mill. Our great water powers adjacent to the supply of raw material should make this pulp and paper industry a permanent source of wealth to the Dominion."

It requires some courage to calculate in figures the vast extent of Canada's pulp wood resources, and, indeed, it is somewhat difficult to frame anything like a reliable estimate in view of the facts that there is no sharp line of distinction between wood that can be used for pulp-making purposes and that which can be used for lumber, poles, etc., and that enormous areas, particularly in the northern regions of the Dominion, are either entirely unexplored or only partially explored. From data furnished about two years ago by the Canadian Forestry Department, it has, however, been estimated that the Dominion pulp wood resources approximated to 2,024,000,000 cords, on about 265,000,000 acres of land, made up as follows: Dominion lands, 100,000,000 acres; Quebec, 60,000,000 acres; Ontario, 40,000,000 acres; British Columbia, 40,000,000 acres; New Brunswick, 20,000,000 acres; and Nova Scotia, 5,000,000 acres. Of the five provinces mentioned, Quebec takes premier rank, not only in regard to pulp wood production, but also in regard to pulp wood still standing unutilised. According to a report prepared by Mr. R. G. Lewis, B.Sc.F., for the Forestry Branch of the Canadian Department of the Interior, and issued on May 25th, 1914, the statistics furnished by twenty-six firms operating thirty-four pulp-mills, showed that, in 1913, 629,934 cords of pulp wood were used,

the quantity consumed in Canadian pulp-mills giving an increase of 28·1 per cent. over that of 1912. The balance of 802,260 cords was exported.

During the last ten years much useful work has been done in survey and exploration work in the Province of Ontario under Government auspices, and some years ago a serious attempt was made in Northern Ontario to calculate the approximate pulp wood contents of each section covered by the survey parties. Referring to the territory north of the Height of Land, the report stated: "There is little pine timber, the trees being scattered and inferior in quality. Some small areas of red pine and some jack pine were met with, nearly all of these varieties found being south of Lake Abitibi. The best areas for pulp wood are on Low Buch and Circle Rivers, with their tributaries, where it is estimated that an area of 180 square miles will yield an average of seven cords to the acre, or about 800,000 cords. Along little Abitibi River, between Harris Lake and the boundary, the pulp wood is estimated at 750,000 cords. A belt reaching from Lower Abitibi Lake along the Abitibi River to Long Sault, eighty miles in length, will average seven cords to the acre. There are also considerable pulp wood areas to the west and north of Lower Abitibi Lake. District No. 2 embraces fifty miles on each side of a base line run west from the 198th mile-post on the boundary line between Nipissing and Algoma Districts to the Missinabie River, about one hundred miles, and also the tract lying southerly along the Missinabie River up to near Missinabie Lake. Of the territory explored, 60 per cent. will yield on an average five cords of spruce wood. The spruce, especially along the river banks, attains a size which renders it valuable for square timber, and the poplar is large and abundant, particularly on the Mattagami River. Special acres examined would yield twenty cords of spruce, other acres would cut fifteen cords of spruce and ten of poplar. Some of these, if all the timber growing on them were made into cord wood, would show sixty to seventy cords to the acre. Survey work along the proposed route of the Hudson Bay River indicates that there are large tracts of country containing a good percentage of wood adapted for pulp."

Again quoting from Mr. Lewis's report, it appears that in 1913 twelve firms operating seventeen pulp-mills in Ontario, used 321,244 cords of pulp wood, the remaining 84,699 cords being exported, the total production having amounted to 405,943 cords compared with 246,282 cords in 1912.

Coming to British Columbia, the same authority shows that, in 1913, 84,173 cords of pulp wood were cut as against 35,067 cords in 1912, and nearly the whole of it was manufactured into wood pulp, only sixty-nine cords being exported. This province, whose pulp wood areas have been roughly estimated at 40,000,000 acres, it is claimed, should eventually be able to furnish half the world with wood pulp, and there can be no doubt that the geographical position of the province is an extremely favourable one, her pulp wood resources being within easy reach of deep-water harbours, while the mildness of the coast climate enables working operations to be conducted practically all the year round. It may, indeed, be said that British Columbia "possesses natural resources of pulp wood and water power which are not equalled by any other province in Canada, the water power on tide-water alone being estimated to be 1,000,000 horse-power, and many billions of feet of pulp wood being tributary to this."

Another important province of the Dominion, from the pulp wood point of view, is New Brunswick, which contains large areas rich in pulp wood trees. As I have already mentioned, these have been estimated at 20,000,000 acres, the approximate production of pulp wood being calculated at 100,000,000 cords. According to the report of Mr. Lewis, the output of pulp wood in 1913 was 194,674 cords, 27·3 per cent. of which was converted into pulp and 72·7 per cent. exported.

There is still another province of the Dominion which presents an increasingly promising field for pulp wood supplies, Nova Scotia, whose pulp wood areas form no mean asset. The Agent-General for the province, Mr. John Howard, informs me that it is estimated that the forest lands of Nova Scotia contain 54,250,000 cords of pulp wood valued at £1 per cord, and I gather from the returns for 1913 that its production of pulp wood in that year amounted to 26,611 cords, of which 22·7 per cent. were exported, the remainder being consumed locally in the manufacture of pulp. There are several—seven, I believe—pulp-mills now in operation in various parts of the province, and owing to the amount of water available in the forest lands, the facilities for shipment, and the contiguity of Nova Scotia to the world's great markets, there are exceptional opportunities for the extension of the industry.

Of other parts of Canada, neither Alberta nor Saskatchewan can really be said to be rich in timber or pulp wood resources, but it is possible that in both these provinces, as also in Manitoba which now reaches to Hudson Bay, the aggregate quantity available will, in the future, reach a respectable figure. With regard to Manitoba, Mr. J. R. Dickson, of the Dominion Forestry Service, who, a few years ago, inspected the proposed route of the Hudson Bay Railway from Le Bas to the Split Lake, a distance of 250 miles, reported that there were fine species of timber of commercial value, including spruce, poplar, birch, and jack pine. The trees, he said, were short, but would be suitable for pulp wood. Mr. Dickson also made the significant statement that it was probable that "within the next quarter of a century part of the enormous energy now running free in the falls and rapids of Nelson and Grass Rivers will be harnessed to drive pulp and paper-mills."

As will be gathered from the statistics to which I have already made reference, white spruce is by far the most important of Canadian timber trees, and is most largely used in the manufacture of wood pulp either in Canada or other countries. It grows in the Dominion from Newfoundland to the Yukon, and its long, tough, and colourless fibres render it specially suitable for paper-making purposes. It is also gradually displacing white pine for what is known as dimension timber and boxes. Spruce is, indeed, used in more than a score of industries, but only in pulp manufacture is it the chief raw material. In one sense its use for pulp may, perhaps, be regarded as wasteful, seeing that, as Mr. R. C. Lewis says, balsam, fir, poplar, white birch, and jack pine can be made into pulp while they are of little value as lumber.

Balsam fir, which in Quebec Province forms from 25 to 50 per cent. of the forests, is steadily increasing in favour for pulp manufacture, and its use in 1913 was 25·5 per cent. of the whole, compared with 19 per cent. in 1912 and 17·5 per cent in 1911. For some years considerable prejudice existed against its use on account of the so-called pitch which it contains, and which injured the felts and cylinder faces upon which the pulp was rolled out. As a matter of fact, the material which gummed up the cylinder probably came from grinding balsam under conditions adapted to spruce wood, and if the logs are left lying in water over a season this drawback practically disappears. Probably more than 25 per cent. of balsam can be used in the manufacture of mechanical pulp without lowering the grade of paper, while, in the production of chemical pulp, the pitch is dissolved by the action of the acids, and any amount of balsam may be used, though in some quarters it is considered that "too much balsam gives a paper that lacks strength, snap, and character." Balsam fir also possesses the merits of readily reforesting cut-over areas and of attaining a size suitable for pulp wood in a short time. This wood is all cut from one species in Eastern Canada, is found all over Northern America, and is becoming increasingly valuable for paper-making. Over 48 per cent. of the balsam cut is employed in the manufacture of pulp wood.

The utility of hemlock for pulp-making purposes was first, I believe, demonstrated by the late Mr. Norman K. Brokaw, of the Kankanna Fibre Company, who is credited with being the first to produce sulphite pulp from it. He is stated, however, to have met with defeat when he sought to convert it into mechanical pulp. More recent experiments in the United States appear to have shown that, when in conjunction with jack pine in the proportion of 25 per cent. hemlock sulphite to 75 per cent. of jack pine mechanical pulp, a paper can be produced which compares well with standard "news" quality. Hemlock now figures third in the list of woods used in Canada for pulp-making purposes, its advance being largely due to its increased use in British Columbia. In 1911 only 1,670 cords were so used throughout Canada, but in 1913 this quantity had risen to 47,360 cords, the average value per cord being $4.25 compared with $6.76 spruce and $6.38 balsam fir. Altogether nine industries use this wood, all of which is purchased within the Maritime Provinces, the pulp industry consuming 8·3 per cent. of the total used.

The Maritime Provinces have also been the sole source of supply of wood pulp manufactured from poplar, of which, in 1913, 4,141 cords, of the value of $7.02 per cord, were used. Poplar has often been considered a non-commercial tree, but it forms a large percentage of the native forests, and is becoming more important as new uses are found for it. It is, I believe, the only wood treated by the soda process, but it is worth mentioning that the aspen variety makes a very white tenacious mechanical pulp. It is said to be easy to disintegrate, and other sorts of poplars are quite as good, but somewhat more difficult to pulp. One authority states that a ton of dry pulp can be got on the average from three tons of wood.

Another wood which is being increasingly used

in the manufacture of pulp wood is jack-pine, which, however, is seldom found clear of knots in large dimensions. In 1912 only 40 cords were treated, but the record for 1913 was 19,383 cords, of the average value of $5.25. The wood, I believe, is being used with advantage in soda and mechanical pulp-mills. The native pine is the second most important wood used in the Maritime Provinces of New Brunswick, Nova Scotia, and Prince Edward Island, being chiefly employed in building construction.

Small quantities—about 1/10 per cent.—of bass-wood and elm were converted into mechanical pulp in Ontario and used mostly for fibre wall-boards.

That the Canadian authorities are under no illusion as to the limitations of the Dominion forest resources, gigantic and wonderful as they are, is evident from the fact that they have already recognised the importance and necessity of adopting careful methods of conservation. As a matter of fact, Sir Clifford Sifton, the Chairman of the Conservation Commission held in Ottawa last January, made the significant remark that there was strong reason for the belief that the forest resources of Canada had been much over-estimated. It is, of course, not difficult to realise the enormous amount of work which has yet to be done by the Forestry Branch of the Department of the Interior before anything like a reliable estimate can be made of those resources, but sufficient appears already to have been done to show how vast they are. Another fact made clear is that there is a great need for adequate fire protection, involving the employment of a larger patrol force than has been previously practicable. The establishment of Dominion Forest Reserves is also an important feature in the policy of conservation, and in this connection it is worthy of mention that during last year (1914) areas in Manitoba, Saskatchewan, and Alberta, approximating to 17,900 square miles, have been temporarily reserved with a view of being later included in permanent forest reserves. Already in the three Prairie Provinces named the net area of forest reserves amounts to 33,225 square miles, while in British Columbia the reservation amounts to 2,749 square miles. In Ontario the present area of forest reserves and parks is 22,574 square miles.

Before leaving what I may call the Canadian section of my paper, brief reference should be made to the excellent work which is being carried out by the Forest Products Laboratories of Canada, which were established in 1913 under the jurisdiction of the Forestry Branch of the Department of the Interior. They are, of course, primarily interested in the conservation of forest resources by proper utilisation of the raw material. The experimental investigation of wood, and of the many products which can be manufactured therefrom, is one of the laboratories' most important and valuable functions, and there is every ground for hope that in the domain of pulp wood real service will be rendered.

Before passing on to the paper-making resources of other parts of the Empire, I ought to refer here to another fibre which has been the subject of some preliminary experiments. This is the common milkweed, *Asclepias syriaca*, which abounds in Canada as well as in North and South America and in the Old World. Dodge states that the only portion of the plant of which practical use can be made is the bast, which furnishes quite a fine, long and glossy fibre that is strong and durable, and which forms a good paper material. Little more than two years ago, Dr. A. C. Neish, before the New York section of the Society of Chemical Industry, describing some experiments to which the plant was submitted, said that "the woody tissue, making up about 80 per cent. of the total weight of the plant, presented the possibility of a new source of material for paper stock," which could be made into paper of good strength and appearance, and which takes dye just as well as other standard stocks. The paper made contained some natural sizing material, as the difference in the sized and unsized papers was hardly noticeable.

NEWFOUNDLAND.

The recent publication of the interim report of the Dominions Royal Commission on the natural resources of Newfoundland, supplemented by other information to which I have had access, renders my task with regard to Britain's oldest colony less difficult than it otherwise would have been. During the last ten years the island, which previously was principally famous for its fish and fogs, has been very much in the limelight by reason of the development of its enormous pulp wood areas by two important British companies—the Anglo-Newfoundland Development Co., Ltd., and the A. E. Reed. of Newfoundland, Co., Ltd.—in whose wake other British and American companies have since followed. The result of these enterprises has been to bring to Newfoundland a period of prosperity hitherto unknown

and undreamt of. In its forest areas Newfoundland undoubtedly possesses vast sources of wealth; but, from the paper-makers' point of view, it is even more important that those forest areas are so rich in woods suitable for conversion into pulp. For a good many years a lumber industry has been carried on upon a small scale, but it is to the wood pulp industry that Newfoundland is indebted for the position that it has now attained. The wooded lands of the island, exclusive of the considerable areas in Labrador, have been estimated to cover 10,000 square miles, with an average yield per acre of ten cords of pulp wood and 1,000 superficial feet of lumber, giving, as one witness before the Commission stated, a total yield of 64,000,000 cords of wood, equivalent approximately to 50,000,000 tons of wood pulp and 6,400,000,000 superficial feet of lumber.

Spruce and fir predominate in Newfoundland forests, but in some sections a considerable proportion of good pine is to be found. The forests of Labrador are stated to consist almost entirely of spruce. The suitability of Newfoundland spruce for conversion into wood pulp has now been well established; but, as in certain parts of Canada, balsam fir is being more extensively used than was at one time thought possible. Indeed, it was stated before the Commission by one witness that his firm got more than one-half of their pulp wood from balsam fir. Newfoundland, not unwisely, ordinarily prohibits the export of pulp wood, so that local manufacture may be encouraged; but is, I believe, destined to do an increasingly important trade in wood pulp and paper. During the year ended June 30th, 1913, no less than 57,500 tons of pulp and 44,400 tons of paper were exported, while the figures for the six months ended December 31st, 1913—pulp, 44,400 tons; paper, 33,700 tons—seem to indicate an enormous advance for the twelve months ended in June last. With regard to the forest areas of Labrador, it would seem that natural conditions are not favourable to anything more than a pulp wood industry being conducted, for which reason it is suggested that the law should permit of the export of Labrador pulp wood under an export duty, as it is considered unlikely that manufacture will be practicable at Labrador for many decades, if, indeed, it will ever become practicable.

As in most other forest-endowed countries, great losses have in past years been sustained by Newfoundland as the result of forest fires; but latterly the organisation of a forest fire patrol by the Government, with the assistance of the operating lumber companies, has, I understand, considerably reduced the danger of loss from this cause.

Thus far I have dealt, as fully as time will permit, with what are the only pulp wood producing countries in the British Empire, and before passing to a review of other actual and potential paper-making fibres from other parts of King George's dominions, it may not be out of place if I utter a word of warning against the tendency which sometimes exists to imagine that the world's supply of timber for paper-manufacturing purposes — whether in the western or the eastern hemisphere—is illimitable and inexhaustible. That this is not the case I have already indicated: but it is necessary to emphasise the fact that the production and consumption of paper is every year increasing, and involves annually a larger absorption of pulp wood, which is the staple raw material of the paper-making industry. Fortunately, the folly of the wasteful and prodigal sacrifice which too often characterised cutting operations is now recognised. The science of forestry is better understood, greater discrimination is being exercised in cutting operations, the preventive measures against loss by forest fires are more complete, and, lastly, the efforts which have for several years past been made to discover other fibres which will supplement those of wood for paper-making purposes are beginning to bear fruit. All the circumstances, therefore, seem to point to a plenitude of raw material which will meet the requirements of the paper industry for several generations to come. This desirable result can, however, only be attained by the conservation of our present sources of supply, and by the unremitting search for those new fibres which, in various parts of the world, are awaiting the opportunity of ministering to the needs of humanity.

India.

Among the various fields of investigation to which chemists and cellulose experts have devoted attention, with satisfactory results, are the vast bamboo-producing areas of India and Burma, where, it has been estimated, there are millions of acres which are either bamboo forests or are perfectly adapted for the cultivation of bamboo. In this connection, valuable service has been rendered by the Forest Research Institute, Dehra Dun, with whose work Mr. W. Raitt and Mr. R. S. Pearson are so honourably

associated. So successfully has bamboo passed the experimental stages, that it may already be said to have come within the realm of paper-making materials, and it is not at all improbable that in the near future it will have taken its place as one of the principal fibres from which paper can be produced, especially in the Far East. Up to the present, however, the only two mills for the pulping of bamboo of which I have recollection are, one belonging to the Mitsu Bishi Company (Japan) in Formosa, and the other to a Tonkin corporation near Haiphong in Indo-China.

The researches of Mr. Sindall, Mr. Richmond, Mr. Pearson, and Mr. Raitt, followed by factory tests in this country and in India, have demonstrated the suitability of bamboo cellulose for the manufacture of paper; particularly printing and litho grade, "provided its isolation has been successfully accomplished," and they show a general agreement that reduction by soda was the only practical method applicable. The commercial exploitation of bamboo was a matter of some initial difficulty owing to the fact that there were several hundreds of species growing over a wide range and variety of latitude elevation, climate, and soil. These, therefore, became the subject of an exhaustive inquiry by Mr. Pearson, the official Forest Economist to the Government of India, who arrived at what proved to be the well-founded conclusion that only five species of bamboo existed in commercial quantities and under economically exploitable conditions. In the course of a paper on the subject of "Bamboo Cellulose," presented two or three years ago at the International Congress of Applied Chemistry, Mr. Raitt stated that "though few in number, these species are so dominant in their own area that they probably represent 80 per cent. of the whole growing stand of bamboo in the country." It may, therefore, be considered that the adaptability of bamboo to paper-making purposes becomes of first-class importance, especially to our Indian Empire, where paper-mills have been not altogether remunerative, owing to the fact that much of their raw material has hitherto been brought from distant lands. Experts have already arrived at the opinion that before long bamboo will become a staple article for the production of paper in India, and Mr. Raitt calculates that it is admirably suited for probably 50 per cent. of the entire trade. "For the better classes of writing and ledger paper," he states, "bamboo pulp is not so useful, as it is lacking in the strength and firmness which is essential for these grades."

My friend, Mr. Samuel Milne, of Messrs. Bertrams, Ltd., who has made a long and deep study of the question of the treatment of bamboo, which, he says, depends more upon the plant than on the chemicals used, emphatically asserts that it is quite safe to say that no fibre available in quantity at the present moment can be superior to bamboo. He maintains that it is suitable for the highest qualities of paper, and, when properly treated, can also be converted into excellent kraft paper. Mr. Milne was good enough to furnish me with several samples of bamboo pulp, and, referring to one of an easy bleaching pulp from Tonkin, he states that it is of the thin walled type and can be treated without difficulty to produce pulp of the highest quality. As a matter of fact, he is of the strong opinion that, properly handled, bamboo can be used for practically anything for which cellulose is suitable. Mr. Milne, I believe, has for a long period been developing an improved method of treatment of bamboo by means of the ordinary caustic soda process with modifications to suit the particular necessities of the material, and to ensure greater economy of working than is at present obtained with the best plants working esparto, and is convinced that suitable bamboo can be converted into an easy bleaching pulp at practically the same cost as esparto. So certain is he of his ground that he is prepared to guarantee results.

In drawing your attention to some slides illustrating bamboo, with which my friend, Mr. Christie, has supplied me, it may be mentioned that the elements of the stem which enter into the composition of the pulp are mainly derived from: (1) The broad zone of fibres lying under the epidermis; and (2) from the fibres forming the sheath of the fibro-vascular bundles running through the whole stem. Besides these actual fibres the pulp contains parts of the large and small vessels with their characteristic markings, parenchymatous cells form the ground tissue and epidermal cells with serrated edges.

In the section of the whole stem the fibro-vascular bundles with their large vessels of wide cavity are seen disposed in fairly regular concentric rings throughout the ground tissue or parenchyma. The enlarged section of a portion of the stem shows the hypodermal layers of fibres and fibro-vascular bundles more clearly.

The longitudinal section of node and internode are chiefly interesting from the structural point of view and call for no particular remarks.

For nearly a generation the leading Indian paper-making fibre has been the baib or sabai grass (*Ischæmum augustifolium*), the similarity of which in appearance and quality to esparto leads English paper-makers in India to utilise it for paper-manufacturing purposes in that country. Again, using Mr. Raitt as my authority, "when carefully collected, free from weeds and foreign matter, it is one of the best and cleanest materials known for the production of the finest printing and medium quality writing-papers." Owing to the fact that no portions of the leaf or flower culm differ materially in composition from other portions, and that even the nodes do not suffer any serious resistance to the action of the digestion liquors, baib is easily reduced to a clean and regular pulp, and the paper made from it is scarcely distinguishable from esparto. Latterly, however, there appears to have been experienced a serious deterioration in quality and falling off in quantity collected per acre or mile. Mr. Raitt, indeed, states that baib is, in short, suffering from the effects of over-cropping, and he suggests that, in the case of certain other grasses, whose crops represent a very much larger weight per acre, factories should obtain control of areas considerably in excess of their annual requirements, so as to permit of portions being occasionally allowed to rest uncropped for one or two years.

I had a very interesting conversation with a Japanese paper-maker last year, who informed me he had completed arrangements for operating his company's mill on bamboo fibre.

This brings me to speak of the Savannah grasses of Northern and Central India, which have been the object of considerable study by the experts of the Forest Research Institute at Dehra Dun, with a view to determining their cellulose or paper-making value. Hitherto paper-making experience of grasses on a practical and commercial scale has been confined to the cereal straws, esparto, and the baib grasses of India, all of which are easily treated as they are not strongly lignified, and their nodes, or knots, are small and easily dealt with. Mr. Raitt, to whose interesting report upon the subject I am largely indebted, states that the Savannah grasses are of a very different type, being much larger and coarser, more strongly lignified, and having hard and large nodes. It is, therefore, encouraging to learn, on his authority, that the need for a strong, long-fibred pulp having some of the qualities which at present can only be obtained by the use of linen and cotton rag may probably be supplied by several of the coarse Savannah grasses common to much of the waste and thinly-forested areas of India. In the course of his report Mr. Raitt entered into an exhaustive examination of these grasses from the physical, analytical, microscopical, and other points of view, with which it would be superfluous for me to deal, but the results of his experiments in digestion with caustic soda are interesting, as showing that of ten species of grasses (List A), only two—*Imperata arundinacea* and *Eragrostis cynosuroides*—proved weak and short in fibre, difficult to bleach, and of little value except as second-class pulps to be used in mixture with stronger ones. The remaining eight species, all of which produced good strong pulps, were—*Saccharum spontaneum*, *S. arundinaceum*, *S. munja*, *S. narenga*, *Anthistiria gigantea* sub. sp. *arundinacea*, *Anthistiria* sub. sp. *Villosa*, *Arundo donax*, and *Phragmites karka*. Eight other grasses (List B) were similarly experimented with, and of these the following were found to yield good clean pulps suitable for mixing with either of the eight I have already mentioned—*Saccharum fuscum*, *Andropogon intermedius*, *A. squarrosus*, *A. nardus* and *Erianthus ravennæ*.

Each of the ten grasses mentioned in List A produced fibres of the long slender type with tapering points, ranging from 4·70 mm. to ·50 mm. in length, the outstanding feature being the marked superiority of *Anthistiria*, as to which Professor Hanausek, of Vienna, a well-known fibre microscopist, reported as follows: "With regard to length, it appears to surpass all other straw or grass celluloses. It must yield an excellent pulp, combining fineness, equality, and strength." Mr. Raitt adds that several of the *Saccharum* group approach it, as also does *Phragmites karka*, while all are regarded as first-class, possessing the features desirable for the manufacture of high-grade writing-papers, or for admixture with second-class pulps like bamboo, in order to gain firmness and strength. The eight grasses which have thus received the benediction of experts, and which are calculated to be capable of adding several million tons annually to the paper and pulp-making resources of India, are found over a wide area extending from Sind to Burma, with the result that there must be wide divergencies of manufacturing facilities, labour, freight costs, etc. Mr. Raitt aptly summarises the position when he states: "As a general rule grass districts connote inland, upland, and comparatively dry country, with long railway leads to seaports, coalfields, and

paper-mills, and an absence of the cheap water transport frequently found associated with bamboo. An exception to this will probably be found in the extensive grass-covered Savannahs on the banks of the Brahmaputra and its tributaries. The cost of cutting and collecting will also be more than for bamboo, as the greater size and weight of the individual culms of this material permits a larger quantity of it to be collected per coolie per day, so that generally, and especially in the absence of water transport, the cost of grass pulp must exceed that of bamboo pulp. This, however, will be compensated for by its better market value."

Mr. Raitt provisionally estimates that the cost per ton of unbleached pulp at the factory would work out at between 100 and 119 rupees, and goes on to say: "Unbleached baib pulp cannot be produced in our local paper-mills with their long railway lead on raw material for less than 155 rupees, and in some instances 170 rupees per ton. The former figure may, therefore, be regarded as their minimum market value, and it is less than the delivered cost of the European chemical wood pulp now being imported to make up the shortage of baib. There is, therefore, a margin on the above estimated costs of from 35 to 55 rupees available for manufacturer's profit and payment of freight to consumer."

Another potential paper-making material which has been described as a native of India, being distributed from the Himalayas to Ceylon and Malacca, is *Hedychium coronarium*, to which Mr. Clayton Beadle and Dr. Stevens drew the attention of the Royal Society of Arts a little more than two years ago. Brazil, however, appears to be the fibre's chief home so far as it may be said to come within the scope of the paper-making industry, and it was in that country, at Morretes, Parana, that rough paper was first produced from it. Subsequent to the Royal Society of Arts communication, Messrs. Beadle and Stevens in my own journal, *The Paper Maker*, and in other ways, have outlined the result of further investigations with regard to *Hedychium*, and it is interesting to note that their tests of some dried-down specimens of the plant from Calcutta were satisfactory in result. They were boiled with 10 per cent. (of 77 per cent.) caustic soda for four hours at two and a half atmospheres, washed free of liquor, and lightly brushed for three hours in a hollander, then made into paper without any sizing material. The conclusion is arrived at that from 80 to 90 per cent. yield of paper on the raw dry fibre weight can be obtained. The paper manufactured from the Calcutta sample is described as "good," although not like the Brazilian, but the yield is said to have been much lower. Unfortunately, however, the upshot of Messrs. Beadle and Stevens' inquiries, stated in their own language, is "that there is no real promise of success outside the State of Parana, Brazil, in which country it grows in wild abundance and profusion." Quite recently the experts I have mentioned have tested a sample of the stems of *Hedychium flavescens* forwarded to Kew by the Director of Agriculture, Ceylon, in order that its paper-making qualities might be compared with that of *Hedychium coronarium*, and I gather that the results of their investigation show that the stems of *Hedychium flavescens* furnish a paper of similar character to that afforded by the stems of *Hedychium coronarium*, but in somewhat lower yield.

Another grass to which the attention of the Research Institute, Dehra Dun, India, has been drawn is moya grass (*Pennisetum Alopecuros*), which, reports state, yields 39 per cent. of easy bleaching pulp similar in quality to that obtained from baib grass. It is said to grow over large areas in the hills of the Central Provinces, and to be capable of collection at a low cost. It is, indeed, considered that in the neighbourhood of the Pench Valley Coalfield --says a Bulletin of the Imperial Institute— 15,000 to 20,000 tons could be collected annually at a suitably situated factory site, at a cost not exceeding 15 rupees (£1) per ton.

Quite a number of other plants, chiefly from India, have also been examined, tested, and reported upon during the last few years, among them being *Iris ensata* var. *Oxypetala*, abundant in Kashmir; *Musa textilis*; and *Spatholobus Roxburghii*, collected in Bengal. The results, however, were not of a very satisfactory character. The leaves of the *Iris ensata* were found to contain 42·3 per cent. of cellulose calculated on the dry material, which is a much lower percentage than is usually present in esparto grass, and it is considered improbable that they could be used as a source of fibre, and that they could compete with such cheap material as esparto grass or wood pulp. *Musa* sheaths contained a much lower percentage of cellulose and a higher percentage of ash than esparto grass. This fibre might be utilised in the manufacture of Manilla papers, but could not compete with Manilla rope. In the

tests of *Spatholobus* negative results were obtained.

There is one other great source of fibre which India might profitably exploit, viz., the cotton seed cotton obtained from the down of the cotton seed by a process of dry mechanical separation. Beadle and Stevens, in recent years, have very carefully investigated the question of the paper-making possibilities of this fibre, and from hulls shipped from India, as well as from the United States, paper has been made. The Indian fibre, however, is of shorter staple than that from the States or Egypt, and, moreover, the notoriously dirty condition of Indian seed prevents the mechanical separation of the cotton being as remunerative as that from the Brazilian or the American seed, the product from which is now used in large quantities in place of rags for the highest qualities of paper, thanks to the mechanical improvements initiated by Minck, and subsequently brought to a state of perfection by E. de Segundo.

Among other Indian fibres to which attention has been directed is lallang grass, in connection with which, it is interesting to recall, the then Sultan of Johore granted a concession in 1902, when the material came under investigation by Messrs. Cross, Bevan, and Beadle, particulars of the results being published in the form of a brochure. This matter has become of greater importance during the last few years on account of the fact that the various rubber estates in the East are obliged to make war upon the lallang grass, and hundreds of thousands of pounds have been expended in uprooting and destroying it. Messrs. Beadle and Stevens, however, brought the paper-making qualities of the grass before the notice of the rubber trade in 1908, and I believe that since that period it has been very carefully considered as a possible means of revenue. The pulp producible is not unlike esparto in its paper-making qualities, but other investigations in the Malay States, where the grass also grows in large quantities, seem to show that lallang is more successful as a paper pulp producer when used in conjunction with different kinds of pulp.

Trinidad.

The sugar plantations of the Western and Eastern hemispheres, too, may be found to yield a paper-making fibre which, treated locally, might form the nucleus of a useful industry. I refer to bagasse, the refuse of sugar-cane after roller-crushing for the expression of the juice, which contains about 50 per cent. of available cellulose, yielding about 45 per cent. of air-dried unbleached pulp. The fact that bagasse is, in most cases, the only fuel which the cane-crusher uses, being much cheaper than coal, would possibly affect the supply for paper-making purposes, but experiments have shown, as in the case of those conducted by Bert de Lamarre in Trinidad, that when mixed with other fibres it produces a useful paper. The best results are said to have been obtained with a mixture of bagasse, bamboo, and Para grass. In Trinidad alone there are estimated to be 50,000 tons of bagasse available per annum. This quantity would yield 40,000 tons of pulp of a value of at least £200,000, or 30,000 tons of a pulp of better quality worth £360,000. Mixed with bamboo and Para grass, the pulp, says one authority, would be worth £450,000. Writing in the *Tropical Agriculturist* four or five years ago, Mr. W. Raitt estimated that the value of bagasse as a raw material for paper-making at the sugar factory was 40*s*. per ton, while its value as a fuel was only about 7*s*. 6*d*. per ton.

Bamboo is, I believe, receiving serious attention in Trinidad. A firm there has been engaged in pulping bamboo for paper-making purposes for some time past.

Australia.

The constantly increasing demand for paper in Australia is chiefly met by imports from this country, Canada, and the United States, but for several years past the idea has been entertained that it should be possible to establish the nucleus of a pulp and paper industry in the Commonwealth. Whether the idea will ever be realised and when, is, however, still in the lap of the gods, though within the last two years a mill for the production of sulphate pulp from a kind of pine wood similar to Riga fir, but of a rather more yellow colour, has been opened at Yarraman Creech, 120 miles north-west of Brisbane, Queensland. At the opening ceremony, the Governor (Sir William MacGregor) described the mill as the first of its kind in Australia. He also expressed the conviction that Australia possessed many growths from which paper could be manufactured successfully, among them being the prickly pear and grass, at the same time considering the destruction and waste of fine timber in Queensland were disgraceful. Upon what grounds Sir William based his conviction I am unable to state, but it is historically interesting to learn that as far back as 1867 the value of some

Australian grasses allied to esparto was discussed in an article which appeared in the report on the Industrial Exhibition in Melbourne, and samples of paper, I am informed by the Agent-General for New South Wales, made from several kinds of grass were prepared by Baron F. von Mueller for that exhibition. That was forty-eight years ago, and the fact that if any further steps were taken in the matter they did not result in anything of a permanent character may be regarded as presumptive evidence that the manufacture of paper from them on a commercial basis was not likely to be successful. As a matter of fact, until the establishment of the Yarraman pulp-mill, I am not aware that the possible paper-making materials of Australia have been tried under commercial conditions. There seems, however, to be a considerable number of Australian grasses, rushes, and sedges which have been proved to be well adapted for making into fibre or paper. These include sedge grass (*Carex appressa*), false sedge (*Carex pseudo-cyperus*), black reed or cutting grass (*Cladium radula*), shining rush (*Cyperus lucidus*), sword grasses (*Gahnia psittocorum*), nodding rush (*Isolepis nodosa*), sea-coast rush (*Juncus maritimus*), small rush (*Juncus pauciflorus*), sheathed rush (*Juncus vaginatus*), tall sword-grass (*Lepidosperma elaitus*), slender sword rush or mat grass (*Lepidosperma flexuosum*), coast sword rush (*Lepidosperma gladiatum*), tussock grass (*Poa coespitosa*), and club rush (*Scirpus fluviatilis*). I am informed that probably the most widely-spread paper-making material native to Australia is the *Cyperus textilis*, a very good fibre plant, found in every part of Australia where swamps exist, which is converted into pulp very easily, and makes, I understand, very good writing-paper. It is a perennial plant, and the annual cuttings give a very good return for the small areas. The sword rush (*Lepidosperma gladiatum*), which I have just mentioned, also grows very well in the extra-tropical parts of Australia along the sea-coasts, and also makes a very good paper. Its principal use at present is for binding sea-sand.

Among other Australian fibres, in addition to the fibrous refuse of Queensland sugar-canes known as "bagasse" (or "megasse"), to which attention has been directed, are those of the black-boy tree (*Xanthorrhœa Preissii*) from Western Australia, *Posidonia Australis* from the sea-coast of South Australia, the prickly pear (*Opuntia*), and the slender spike rush (*Eleocharis acuta*). With regard to the last-named, many years ago Dr. Mueller spoke of it as a good paper stock, stating that the local experiments showed it and other cyperaceous plants to be well adapted for good printing and tissue paper and a by no means inferior writing-paper.

Tasmania, the smallest of the States of the Australian Commonwealth, is famous for its variety of forest trees, and it is possible that in these days of scientific research the time is not far distant when much that is now destroyed as worthless in the Tasmanian forest will be utilised for many purposes at present unthought of. Whether any considerable portion of it will ever be devoted to the production of pulp for paper-making purposes is difficult to say; but I am interested to learn from Sir John McCall, the Agent-General for Tasmania, that the Government are engaging an expert to visit Tasmania to report on the possibility of establishing the wood pulp and paper-making industries there. The question is, of course, a new one for Tasmania, and I understand that up to the present only experiments have been conducted with a view to testing the adaptability of Tasmanian timbers and fibres to paper-making uses. Sir John McCall, however, was good enough to send me a specimen of paper made from the blue gum tree (*Eucalyptus globulus*), which it may interest some of you to examine. The wood from which the paper was made was sent to this country for telegraph arms, and had been exposed to the weather for some three years. Some pulp has also been made, I am informed, from stringy bark (*Eucalyptus obliqua*), and there are many other kinds of wood which it is considered will be equally adaptable for the purpose of paper-making. Should this prove to be accurate, a valuable by-product will have been discovered.

NEW ZEALAND.

I have unfortunately been able to trace but little official or authoritative report upon the pulp-producing resources of this beautiful country; but, through the kindness of the High Commissioner for New Zealand, I have been afforded the opportunity of perusing a little work on "New Zealand Timbers and Forest Products," written by Sir Westby B. Perceval, K.C.M.G., a former Agent-General for New Zealand, who mentions three species of wood which had been suggested as admirably adapted for the manufacture of wood pulp. The first is the white pine (*Podocarpus dacrydiodes*), a large timber tree, the wood of which is very white, cheap, and plentiful all over

New Zealand, and which is called by the natives "Kakika." Of the second, houdere (*Hoheria populaea*), he states that it is found all over both islands, grows to a height of 45 ft., and a diameter of 2 ft., is white in colour, plentiful and cheap. The third tree is named Ti kouha (*Cordyline Australis*), and grows on river banks and on the margin of boggy woods to a height of 30 to 40 ft., and a diameter of 5 ft. The leaves of this plant, writes Sir Westby, afford a material for paper-making of great value, as well as fibre for cordage.

Dodge's valuable work on "Useful Fibre Plants of the World," indicates that the second of the three woods I have mentioned is the ribbonwood of Otago, resembling the aspen tree. It also quotes Dr. Guilfoyle's opinion, that "the delicate lace-like bast from its young branches, being strong and glossy, might be used for other purposes than matting and string." Whether any serious attempt has been made to determine definitely the adaptability of either of these fibres I have not yet discovered; but though the Dominion undoubtedly possesses forests containing certain kinds of woods suitable for paper manufacture, it seems probable that most of it is too hard for cheap conversion into paper, and that it can be used more profitably for other purposes.

Experiments have, however, been conducted with a view to ascertaining whether plant fibres grown in New Zealand may usefully be adapted to paper-making purposes. Among these is New Zealand flax (*Phormium tenax*), a fibre extensively grown in the islands and of more particular value for textile purposes. From this, Messrs. Beadle and Stevens inform me, very strong paper was produced. The fibre has been the subject of a somewhat extensive inquiry by the New Zealand Government with a view to its cultivation. Dodge states that *Phormium tenax* will grow in almost any soil, but best on light rich soil by the side of rivers and brooks, where sheltered from the wind. He says that a well-drained swamp gives large returns, and that on the best lands an acre may contain 2,000 bunches on the plant, or 100,000 leaves. The planting, however, must be very close.

British Africa.

Under this comprehensive heading I propose to discuss, as fully as time will permit, some of the numerous fibres growing in those parts of the great African continent which are within the British Empire. It is, of course, impossible to do more than to touch the fringe of what is really a vast subject, but sufficient may be said to indicate the immense possibilities these regions furnish for the extension of the world's paper-making resources.

Commencing with South Africa, whence from time to time come rumours of enterprises having for their object the manufacture of pulp and paper, it must be said that the question of what native fibres are suitable for paper manufacture is as yet only partially decided. During recent years, experiments have proved pretty conclusively, it is stated, that a number of fibrous materials are particularly suitable for the purpose. Among these may be mentioned maize and banana leaves, the prickly pear, sisal hemp, wattle bark, tambookie grass, papyrus grass, and bagasse. I understand, however, from Mr. A. Canham, the Acting Trades Commissioner of South African Government, that up to the present only three classes of material—the three last-named—have been experimented upon. Vast areas of country in Zululand and Northern Transvaal are covered with papyrus and tambookie, and it is thought that if the material could be worked up into a pulp in South Africa, and exported in that form, a very large trade could be done. As a matter of fact, Mr. Canham informs me that quite recently the South African Government leased to a firm in Johannesburg certain ground in Zululand for the cutting of papyrus grass, and that he had been advised of the dispatch of 25 tons of that fibre to this country for purposes of experiment. Last year a sample of papyrus was forwarded to the Imperial Institute and was made the subject of a report, from which I gather that it was obtained from the St. Lucia Bay districts of Zululand, and consisted approximately of 80 per cent. of stem and 20 per cent. of leaf tufts. Upon the completion of the tests it was found that the yield of pulp was less than the quantities obtained from papyrus stems from East Africa and the Sudan. The pulp was readily obtained from the papyrus by heating with caustic soda under pressure, and was easily bleached, being thereby rendered almost white. Paper-making trials showed that the pulp could be converted into a satisfactory paper of good strength. Unfortunately the conclusion arrived at was that, owing to the rather low yield of pulp and the bulky nature of the papyrus, it was unlikely that it could be profitably exported to Europe in the crude state, in which it would probably not realise more than about £3 per ton in the United Kingdom. It could, however,

be converted in South Africa into "half-stuff" for export, or it could be used locally for the manufacture of paper. Mr. Canham was good enough to send me two samples of the paper made from papyrus stem and leaves, which may be of interest.

Even a more satisfactory report was made by the Imperial Institute upon tambookie grass from the Transvaal, which grows luxuriantly over large tracts of country. The results of the chemical examination of the grass in comparison with Algerian esparto grass from Oban showed that the yield of unbleached pulp (dried at 100-110 c.) expressed on air-dry material was 37·1 per cent. compared with 29·3 per cent. esparto, and expressed on material dried at 100-110 c. the percentage was 41·3 compared with 32·3 esparto. The yield of bleached pulp (dried at 100-110 c.) expressed on material dried at 100 110 c. was 40 per cent. as against 32 per cent. esparto. The report states that on heating with caustic soda solution under pressure the tambookie grass was readily converted into a light fawn-coloured pulp, which was very easily bleached to a pure white product. While the yield of pulp was unusually high the average length of the ultimate fibres (0·081 in.) was considerably greater than in the case of esparto (0·045 in.). Paper-making trials carried out at the Imperial Institute showed that a satisfactory paper of fairly good strength could be produced, as will be seen from the unsized and unfinished specimens which I have here. The high yield of pulp of good quality and the ease with which the pulp was bleached show that tambookie grass is well adapted for paper-making, and the crude material would probably be worth about £4 per ton in the United Kingdom. It is, however, considered that it would probably be more remunerative to convert the grass into "half-stuff" in South Africa, and either send it to Europe or utilise it locally for the manufacture of paper.

In connection with the mention of wattle bark as a paper-making material, I was interested a few years ago in reading in the *Chemical Trade Journal* an article on "The Chemical Industries of Natal," in which wood distillation and wood pulp and paper-making were included among probable industrial developments in South Africa. The writer, after stating that every year many thousands of tons of wattle wood from which the bark is stripped find no use, and that its suitability for distillation was second to none, went on to assert that the wood would form the raw material for paper-making purposes, and that tanning compounds, which exist in the wood to a less extent than the bark, would pay for extraction before the pulping process commenced.

A fibre which has been the subject of paper-making trials at the Imperial Institute is Spanish reed (*Arundo donax*) from the Transvaal. The species of this grass known to the ancient warlike Jews, I may parenthetically remark, was greatly valued by them after they began to practise archery with effect, because its long, straight, and light canes made excellent arrows. A fairly good paper was made from the sample tested at the Imperial Institute, but the chemical examination showed that, compared with esparto grass, the yield of pulp calculated on dried material was 27·6 per cent. as against 32·3 per cent., and the loss on bleaching was much greater. On treatment with alkali the pulp was pale yellowish-brown and was easily bleached.

Aristida sp. from the Transvaal was also experimented with, but the paper produced from it was generally of poor quality, mainly through the shortness of the ultimate fibres of the pulp. It is, therefore, considered doubtful whether this grass could be used alone for paper-making, and that it would be necessary for it to be employed in conjunction with material having longer fibres.

Among other fibres from South Africa which have been brought under the notice of the Imperial Institute were *Helichrysum* from the Transvaal, and *Moræa tricuspis* from the Cape of Good Hope. Results of tests showed that the leaves of *Helichrysum* would no doubt serve as a paper material, as they contain a large proportion of cellulose and an ultimate fibre of good length. This, however, would depend upon the cost of the material as compared with that of esparto grass or wood pulp and upon the quality of the paper it would yield, a point which could only be ascertained by technical trials with large quantities of the material. *Moræa tricuspis* fibre contained a higher percentage of fibre than esparto, and could, no doubt, be utilised for paper-making, though perhaps only locally.

From other parts of British Africa have come many other more or less likely paper-making fibres, but I think the purposes of this paper will be adequately served if reference is now confined to those which appear to present superior possibilities from the paper manufacturers' point of view. In this category may be placed the baobab tree (*Adansonia digitata*) which grows in great abundance in West and East Africa and is often called the "monkey

bread tree of Africa." The tree grows chiefly, I believe, in immense clusters or small forests near the sea and is rarely far from the coast, and is one of the largest and longest-lived in the world. It is said to possess properties which render it of exceptional value for paper-making, and is used by the natives for the manufacture of ropes and sacking. Something like thirty years ago it was held in considerable esteem in this country by manufacturers of "small hands" (strong light-coloured wrapping papers), and good parcels are said to have ranged in value from £8 to £10. In order to prepare the fibre, the hard outer bark is first removed by chopping, and the inner bark is then stripped off in large sheets. About three years ago Mr. P. H. Stormont, the Acting British Consul-General at Dakar, reported that "the baobab makes a paper of superior quality and durability suitable for banknotes," which seems to be an advance upon the uses to which it was put a generation ago. He also observed that, added to other pulps in small quantities, it imparted a gloss and finish to the paper. A concession to work some baobab forests was granted a few years ago to a French company, but owing to wrong methods of working and lack of funds the factory was abandoned. It has since been suggested, however, that with fresh capital and under good management the concession would be made to yield a good profit.

Elephant grass (*Pennisetum purpureum*) is another plant which has occupied the attention of the experts of the Imperial Institute, with results that suggest that "if the stems were converted into pulp in Africa by treatment with caustic soda, it is possible that a remunerative industry might be carried on, since the pulp would probably be of approximately the same value for paper-making as wood pulp prepared by the soda process." A perennial grass, it occurs in a wide zone across tropical Africa, and is found chiefly along watercourses and in marshy depressions, but also grows in the more open parts of the bush and forest, while in the delta of the Zambesi and along the Shire River it forms extensive reed jungles. Tests of a sample of the dried mature grass from Uganda, weighing 177 lb., were some time ago made at the Imperial Institute. The pulp was a good colour, and was composed of ultimate fibres rather longer than those of esparto and of about the same length as those of bamboo pulp, and the sample furnished a fairly good paper. No difficulty appears to have been occasioned by the nodes, and it is considered that there is no necessity to cut them out when utilising the stems for paper-making. In view of the fact that Togoland is now in British hands it may be interesting to mention, however, that the nodes are stated to have caused some difficulty in trials carried out in Germany with elephant grass from that part of Africa.

Considerable attention has also been paid within recent years to the papyrus of the Sudan as a possible fibre for paper-making purposes. It is, of course, unnecessary here to refer to the historic connection of papyrus (*Cyperus papyrus*) with the making of paper, but it is interesting to recall that the ancient Egyptians used it in the preparation of writing-paper, which was made from the inner bark of the stem. Time, however, prevents me doing more than allude to the tests which have been applied to the fibre with a view to ascertaining its utility under modern paper-making conditions. Samples of papyrus from the Sudan and the East Africa Protectorate were some time ago experimented with, when it was found that the yield of pulp from the East African papyrus was slightly less than that from the Sudan sample, but was of similar character and quantity. Paper-making trials showed that the manufacture of fairly good paper from this material is possible. Expert opinion, however, was to the effect that the air-dried material would not realise so much per ton in this country as esparto grass. The commercial possibilities of papyrus have more recently been the subject of further investigation in connection with the flotation of a company for the production of sudd fuel and papyrus pulp, and with regard to the latter it was stated that "it would be possible to place on the London market, at a cost of three guineas per ton (including transport, canal dues, etc.), unbleached papyrus pulp, the sale price of which has been estimated by experts at £6 10*s*.," leaving, roughly, a net profit of about £3 a ton. It was, I understand, decided by the company to introduce a pulp-making plant on their site in the vicinity of Lake No, and if results justified it a subsidiary company was to be formed for the purpose of pulp manufacture. Of later developments, however, I have, unfortunately, no personal knowledge.

Federated Malay States.

For some years past suggestions have been made in the direction of paper-making in the Federated Malay States. In the year 1910 a gentleman largely interested in that country gave, in the ***Financial Review of Reviews***, an

article, in which he referred to the wastage of wood, and expressed wonder that "in this age, when wood pulp has grown in value as a marketable commodity, it had not occurred to someone to make revenue out of the vast quantity of timber now wasted in the Malay States." So far as I am aware, however, nothing practicable was done in this direction, and the paper required there is still sent from Europe, or in even larger quantities from China. Quite recently an important British company, controlled in London—a company, by the way, concerned particularly in the growth of rubber—has been experimenting with pineapple leaves and the nipa palm, with a view to turning these fibres to commercial account.

One of our leading experts has been employed in ascertaining the commercial value of these fibres, and with regard to the pineapple fibre it was found that these samples intended for textile use were promising, although probably the experiments made up to the present are somewhat indefinite. Pineapple combings gave excellent results for paper-making, and the samples of paper made in London recently appear to offer considerable promise, although apparently the combings were somewhat dirty, and this is obvious when the samples are examined. It was found that, taking an average sample of pineapple combings and treating the same by the soda process for the manufacture of paper pulp, digesting for six hours with caustic soda at 50 to 60 lbs pressure, there was a yield of unbleached fibre of 38 per cent. The material was strong, but it will be noted that the yield was low. In another test, where the fibrous matter was selected, a yield of as much as 73 per cent. of useful fibre resulted, and the general testing indicated that by proper separation of the more fibrous portion, with suitable mechanical appliances, a good product is readily obtainable.

Mr. Clayton Beadle, who, I may mention, made these tests, came to the conclusion that the experiments all tend to show that a clean combing of the pineapple leaves will give a strong, serviceable pulp, capable of being bleached to a good colour.

The sample of nipa palm, also submitted by the same rubber company to Messrs. Sindall and Bacon, has, within the past few weeks, been very carefully experimented upon, and some of the samples produced are distinctly promising. I understand that the freight to Great Britain on rough pulps would be in normal times about 27*s.* or 30*s.* per ton in bales, and probably firms interested in making strong brown papers, or fibre boards, might, under favourable circumstances, turn the nipa palm fibres to good account.

I learn that the fronds gave a somewhat low yield of pulp, which pulp, however, is capable of being bleached readily, but the combings with 15 per cent. of bleaching powder gave a yield of bleached pulp of 29 per cent. and the pulp is of excellent quality, although showing traces of iron rust. The lowness of the yield is an important factor in the consideration of this fibre. Having regard to the poor yield of bleached paper pulp obtained, Messrs. Sindall and Bacon have made an experiment for the production of tough boards from the combings with a minimum of chemical treatment. The raw material was, I learn, simply warmed for two hours in a very weak solution of caustic soda in an open vessel. The product was washed and treated in a beating engine, and finally made up into thick paper, a sample of which I have here, and the result is a tough, strong board, suitable for boxes, fibre and portmanteau boards. This experiment indicates that the combings can be put into a beating engine and converted directly into tough, fibrous boards without any chemical treatment whatever, and not only boards, but tough wrapping paper could be cheaply produced. Thus, it is pointed out, a material quite unsuited for white papers can be profitably utilised for strong wrappers and stout box boards. I have reason to hope that further experimental work will be carried on in the Malay States, and although these fibres are not likely to revolutionise the paper-making industry, they offer promise as a material for box boards.

For those interested in the subject I will present a conventional diagram of the arrangement of a small experimental plant such as Messrs. Sindall and Bacon have actually recently designed, and a plant of this type has been made in London by Messrs. T. J. Marshall and Co., of Stoke Newington. It is estimated that a small plant capable of producing 10 or 12 tons per week would cost, approximately, £3,000, and a small experimental plant capable of producing paper or pulp boards 12 ins. wide would, I suppose, cost £350 or thereabouts.

It is interesting to note that the Government has shown considerable interest in regard to the development of fibres in the Malay States, and this interest has taken practical shape, as a small experimental plant for the treatment of fibres has been installed in order that the experiments may be continued.

I am now approaching the end of my task, but before bringing this somewhat discursive and, it is to be feared, incomplete review of "The Empire's Resources in Paper-Making Materials" to a close, it may not be out of place if I briefly allude to one or two considerations which have occurred to me as bearing upon the situation brought about by the great struggle in which this country with its Allies is now engaged. May we not, for instance, legitimately ask ourselves how far the British Empire is of itself able to furnish the raw materials for the paper-making industries in its own borders?

Our present dependence upon the Scandinavian countries for supplies of chemical and mechanical pulp has not been without a certain amount of risk to the interests of the British paper-making industries, and it is conceivable that had Norway or Sweden ranged themselves in the ranks of our foes, or been effectively prevented from conducting their export trade, a serious position would have arisen. With a ready market for its pulp exports at its own door, and with contracts to fulfil, Canada could scarcely be expected to meet anything like the requirements of this country. Where, then, should we have looked?

Surely, therefore, it becomes a matter of supreme importance that we should endeavour to supplement what may be described as our foreign sources of supply with those which are awaiting exploitation and development within our own world-wide Empire! Inquiries tend to confirm the belief that various parts of the King's dominions are rich in fibres adapted to paper-making purposes, and that there is a vast field over which "the banner of England flies," towards which British science and enterprise may profitably be directed. Many of the fibres to which I have referred have probably no real commercial value from the paper-makers' point of view, but there are others whose utility have been amply demonstrated. As yet, however, we are but on the fringe of a world of possibilities, in which even the desert places of the earth, the swamps and marshes of virgin lands, as well as the unexplored forests of two hemispheres, may possibly minister to that industrial, commercial, and intellectual progress for which paper is so great a necessity.

Before closing I would like to express my great appreciation of the encouragement and assistance I have received from Professor Dunstan, Director of the Imperial Institute; and the selected reports from the Scientific and Technical Department of the Institute bearing on fibres and issued as Colonial Reports (Miscellaneous), are of extreme value and contain a mass of information of first-rate interest to paper-makers. No. 58 (Cd. 4588) is well worth perusal, and Volume No. 12 (1914) of the Official Bulletin also contains a number of matters showing how the Institute has thoroughly investigated fibres which may be of more or less use in paper-making.

I am also greatly indebted to Professor Dunstan and Dr. Goulding for the loan of some specimens which are not available to the general public, and these I have very much pleasure in handing round. They are exceptionally instructive, showing, as they do, the plant, the fibre in various stages, finished papers, and particulars are given as to the yield and general characteristics. Other Imperial Institute bulletins of interest are No. 3 of Volume 10 (1912) and No. 1 of Volume 11 (1913), the last-named dealing specifically with elephant grass.

To Mr. J. M. Hillier, Keeper of Museums at the Royal Botanic Gardens, Kew; Mr. R. W. Sindall, Mr. Bacon, Mr. John Christie, Mr. Clayton Beadle, Dr. Stevens, and others I am also greatly indebted for many useful suggestions and much useful information, and to all I tender my sincere thanks. May I also add an expression of my sense of the honour conferred upon me by the Hon. Sir George Perley, a member of the Canadian Government, in consenting to preside on this occasion? Sir George's official position in Canada and in this country, as well as his association with the great lumber industry of the Dominion, render his presence here singularly appropriate and significant, and I am sure you will all share my appreciation of his kindness in consenting to take the chair this evening.

DISCUSSION.

THE CHAIRMAN (the Hon. Sir George Perley, K.C.M.G.), in opening the discussion, said he was greatly interested in the subject, because before he took up the business of serving the public he was engaged in Canada in the timber and lumber manufacturing business. In his younger days he handled nothing but white pine, but subsequently some red pine was dealt with. White pine was the wood of the greatest value in Canada, but of late years, owing to the increase in the pulp-making industry, spruce had come very much to the front, and was being cut down and used very extensively in Canada. The author had stated that white spruce was the best wood for pulp-making, but

balsam was used with it. Those two woods were cut together and manufactured together, and that plan seemed to work very well indeed. The slide the author had shown of a white spruce was rather unfair to the white spruce of Canada, because it was a field spruce growing in the open, whereas the spruce trees in that part of Canada from which he came were of a large size, occasionally having a diameter of 3 ft. at the base. The black spruce grew only to a small size in Canada. Spruce and balsam grew almost everywhere in Canada, the quantities being small in the prairies in the west, but in every other part they were very numerous. The endeavour of the pulp-mills was to get enough timber at their command to keep them going indefinitely. In his experience spruce grew about 3 per cent. in a year, *i.e.*, in thirty-three years it would reproduce itself, so that a mill which had enough standing timber to last it for about thirty-three years could practically go on indefinitely. The science of forestry had not made a great deal of progress in Canada except of late years. Latterly a good deal of attention had been given to it, and some of the large pulp companies employed trained men for the purpose of estimating their timber, finding out the best way of preserving it, and making it a perpetual business. Fire had been a very serious danger in Canada; in fact, to his mind there was no question that more timber had been burned in Canada than had been cut. Of late years it had been found possible to regulate that to a very large extent. Most of the standing timber in Canada was on land that still belonged to the Crown—*i.e.*, it was owned by the different provinces of the Dominion or by the Dominion itself, and the firms or individuals who were in the lumber or the pulp business leased that land from the provinces or the Dominion under certain regulations. They paid a stumpage to the Crown when they cut the timber, and consequently both the Government of the provinces or of the Dominion and the company or the individual who had leases from the Crown were interested in preserving the timber. Of late years a very good system of fire control had been developed by employing men to watch the fires and put them out when they were in an incipient stage; that had been comparatively inexpensive, and had produced very good results. The people of Canada intended to pay more and more attention to that very important question, in order to conserve their immense supplies of timber.

Sir Daniel Morris, K.C.M.G., D.C.L., D.Sc., expressed his appreciation of the wide survey presented by Mr. Phillips of the Empire's resources in paper-making materials. It was, however, impossible in the short time available to discuss the relative merits of the numerous subjects referred to. He (the speaker) had been closely interested in the scientific investigation of many of them. He did not wish to discourage efforts that were being made to utilise such sources of paper-making as the bamboo, the gingerlike *Hedychium*, the megass of the sugar-cane, the papyrus and the numerous tropical and sub-tropical grasses that had been referred to, but he must frankly say that he was not hopeful that any of them could replace wood pulp as long as the latter was obtainable in adequate quantity and at prices not appreciably higher than those now ruling. If the vast forest areas existing in the Dominion of Canada and in Newfoundland were efficiently protected from destructive fires, and dealt with under more scientific and remunerative methods, they would prove enormous sources of wealth. It was encouraging that in recent years Canada had increased its forest reserves for the production of lumber and wood pulp from 7 to 152 million acres. The speaker then referred to the resources of Newfoundland, which he thought had not received the attention they deserved. He recognised that Newfoundland was now the home of two of the world's finest paper-mills, and that was proof of its unequalled pulp wood resources, but its enormous capabilities for further extension appeared to be only very slowly realised. Its proximity to the British Isles, its unlimited supply of small spruce and fir growing thickly together and conveniently located near the numerous lakes and rivers, and its comparatively abundant supply of cheap labour, appeared to give Newfoundland a great advantage over any other portion of the Empire in the production of wood pulp and paper.

Mr. Alfred W. Foster (Secretary of the Paper Makers' Association of Great Britain and Ireland), speaking from the point of view of the paper-makers, said they were prepared to make paper from any fibre that was capable of being turned into paper, but it was necessary for the Empire in supplying them with the fibre to remember two things, the first being that paper nowadays was not intended for permanent use. The paper-maker who made paper for the periodical press had to produce an article which had a life of only a few minutes or a few hours, and further which had the peculiar property that the more flourishing was the concern which turned it out the more of it they had to give away for the same money. A paper which was not flourishing was small in size and consumed little paper; the prosperous newspaper having a large advertisement circulation gave away from twelve to twenty pages of the same size. Therefore a paper-maker who was making news had to turn out something which would not be durable but cheap, and the whole point with regard to fibre from which newspaper was to be produced was that it should be brought to this country and marketed at the cheapest possible

rate. That did not apply to certain high-class forms of writing-paper, the material for the production of which was ample and would not be exhausted. The principal problem in regard to the production of fibre was so far as it related to the very large class of cheap papers, particularly of news. That meant that paper-makers in this country had to be supplied with some material which could be used to turn out paper at a penny a pound. The practical point which it was necessary to bear in mind in considering the fibres available in different parts of the Empire was that the manufacturers of paper for newspaper purposes must have either the waste by-product of some other industry, such as the crushed fibre of sugar-cane, or some plant or tree which would grow wild without the expense of labour for the purposes of cultivation, and that was the practical limitation from the paper-maker's point of view of the fibres that could be used for the basis of his product. Apart from that, paper-makers could use any vegetable substance which was capable of giving fibre, and they looked with expectation to their commercial friends within the bounds of the Empire to point the way to those vegetable fibres, and to their scientific friends to show the practical method of turning them to use as the basis of the paper-making industry. On behalf of the Paper Makers' Association, he desired to add his thanks to the author for one more addition to the many very useful contributions he had made to the success and prosperity of paper-making.

Mr. Clayton Beadle said he remembered that at the Indian and Colonial Exhibition, which was the first systematic attempt to investigate the various fibres collected from different parts of the Empire by a number of experts, Mr. Routledge was endeavouring to introduce bamboo for paper-making purposes, he already having previously successfully introduced esparto. He also remembered that Mr. Lloyd, the founder of the present firm of Edward Lloyd and Sons, and father of the present generation, was at that time also looking out for new sources of supply for the manufacture of news, and that Mr. Donkin, a member of the firm of Bryan Donkin, was also greatly interested in the subject. The reports which were issued subsequent to that exhibition—one dealing with the colonial fibres being issued under the auspices of the Royal Society of Arts, and another dealing with the Indian fibres being issued under the auspices of the Indian Government—were very exhaustive, and the methods there employed had formed the basis of the methods used by chemists during the last twenty years. He had had a good deal to do in this country with marram grass, which abounded in certain districts and which was very valuable as a sand binder. It grew very thickly, but its yield, as compared with esparto, was somewhat disappointing. Nevertheless it was possible that that fibre might be of service in the manufacture of certain classes of printing paper, and it was the only fibre that he knew of in this country which showed any promise of being of service in that direction. A good many years ago, and again recently on behalf of the Rubber Growers' Association, he had a great deal to do with lalam grass. It had proved itself a pest to the rubber growers, and it had now been eradicated by burning and rooting it up. It was a paper-making plant, but it was regarded as an enemy by rubber growers, and he therefore thought very little would come of it. In conjunction with Dr. Stevens, he had under examination forty-three plants sent over from India which had all been classified at Kew, from many of which paper had been made. They were closely allied to the *Hedychium*. He had been dealing with the *Hedychium* for the past few years, and it was in the Theatre of the Royal Society of Arts that it first got to be known. Cultivation was being attempted by different governments in the British Possessions as a result of the first tests that were made, and, to his mind, it was the most promising paper-making fibre of the future, apart from the present fibres that were available, for the production of strong and cheap papers, wrapping, kraft, and so forth, but certainly not for the manufacture of news. The author had referred to the cotton-seed hull, which he (Mr. Clayton Beadle) had under investigation a good many years ago. The cotton-seed hull was a mere waste material up to recent years, one or two million tons of it being burnt every year or dug into the soil, and probably in the British Empire 100,000 tons of cotton had been going to waste every year as a waste product which might be rendered of service in the manufacture of paper and explosives. He went over to Germany many years ago to investigate a process for the removal of fine cotton from the cotton hulls by a process of mechanical separation, but it was a very difficult method to introduce to the paper trade, there being a great deal of opposition to it. It had now, however, become a very important source of material not only to the paper trade, but also in the manufacture of explosives and for similar purposes. That particular product was of interest in another way. If the seed-crushing industry was studied, it would be found that the method of seed-crushing in this country was entirely distinct from that of the United States. In the United States the seed was decorticated, and the hulls were produced as waste products. In this country the seed was crushed whole, and the process of decortication did not come in. It had now been discovered that, instead of taking the hulls and removing the cotton from them by the winnowing process, the whole seed could be passed through a machine, and the

down from the seed, after it had gone through the ginning operation and the lint had been taken off it, could be winnowed off and collected, and that amounted to something like 10 per cent. upon the weight of the seed. That was a very valuable cotton fibre which, when bleached, was of service in the very highest class of paper and for use as explosives, and it fitted in with the method employed in this country for seed-crushing. He thought a good deal more would be heard of that in the future. By a curious coincidence he had only that morning been watching a machine separating the cotton in the above-described manner from Uganda seed, which gave an excellent cotton as a raw material for paper-making, a sample of which he produced. There would be nothing to prevent all Uganda and suchlike seed from being treated in this manner. He believed he was the first to examine the British Columbian spruce, balsam, and hemlock for the purpose of making them into sulphide pulp on a small scale, that is, before it was attempted commercially. The wood was something like 2 ft. in diameter, and he counted rings in it which made it something like 170 years of age. The wood was of uniform good quality in all three cases, and the length and strength of the fibre were equal to those of any sulphide pulp which had been produced in any other country. With reference to the possibility of the utilisation of wood in this country, he hardly considered it a practical question. He remembered that Sir Edward Partington, who was not only one of their greatest paper-makers, but pulp-makers, stated that he thought it would almost pay to take some of the timber in this country and convert it into pulp. Whether he was speaking seriously or not, he (Mr. Clayton Beadle) did not know, but he did not think it was really worth consideration. It had been decided by men who had studied the question seriously that it was hardly within the range of practical politics. With regard to the qualifications of fibre, he quite agreed that almost every fibre was capable of conversion into paper of sorts, but they seemed to begin at the wrong end of the stick somehow or other in investigating a fibre to see whether paper could be made from it. That was only one of the things to be considered; there were all kinds of various qualifications to be borne in mind. The abundance of supply was a very important factor, and if it was a question of cultivating it that almost seemed to him to put the possibility of a cheap supply out of the question. It was necessary to find some part of the world where fibre existed in abundance, where it reproduced itself without cultivation, and could be brought to a port of shipment or to a mill at a very low cost. Some fibres were excellent for the production of paper, but were very bulky, and the question of the freight was therefore of considerable importance. He had recently been dealing with the question of the compression of different fibres in order to get their volume down to dead weight for shipment. It was quite impossible to get some fibres closely packed into bales, and even if one were successful in doing so their qualities were spoiled. Compression beyond a certain point must be avoided, otherwise the fibre was damaged to a very considerable extent as a raw material. Then the question had to be considered of the adaptability of the fibre and so forth for the kind of paper for which it was required. Fibres were now required not so much for high-class papers, but for common papers, in which nine-tenths or more of the raw material was being used. We lived in a country where practically nothing was produced in the way of raw material for the manufacture of paper, so that it was dependent for its supplies on an article which came over the seas from various parts of the Dominion. Taking the British Empire as a whole, he could not help thinking that, in the matter of supplies for the manufacture of paper, it was more self-contained than in almost any other industry, and that there were possibilities of finding raw materials in different parts of the Empire sufficient for its service for several generations to come.

Mr. R. W. Sindall estimated that fifty million trees were being cut down every year for the production of paper pulp. He had had two years' experience in Canada from that point of view, and was surprised to see the careless way in which the forests were treated. The conditions under which the firms were allowed, when he was there, to lease the forests militated against any scientific forestry. He was glad to see the Colonial Governments were now so active in regard to the matter. There were several difficulties in the way in the use of bamboo and fibres other than wood. In the first place, they could only be used for the manufacture of chemical pulp. Fibres were required which could be cheaply converted into a pulp, and, unfortunately, bamboo could not be treated by any mechanical process. Another fancied difficulty connected with bamboo was that frequent cutting injured the stools, so that the plant could not reproduce quickly. There was no certain information on that point, and he strongly recommended the Government of Burma, when he was sent out by the Government of India to investigate the possibilities of bamboo in that country, to look into that question, and see how it affected the reproduction. He believed this point had been satisfactorily settled. Another point connected with bamboo was that many species flowered and then did not reproduce for several years afterwards. A paper-mill dependent for its supply on an area where only one species was growing would find it necessary to take a very long

holiday before the supply could be reproduced. That was, of course, got over quite readily by varying the species. The Queensland Government had sent over to him for investigation a large quantity of prickly pear, and it seemed to him to promise paper of a certain kind. The chief difficulty was to find fibres which could be applied to all varieties of paper. It seemed to him that *bamboo* and *Hedychium* were two promising fibres, and they could be utilised for the manufacture of chemical pulp.

Mr. F. Crosbie Roles said that mention was made in the paper of the latest attempt to produce papyrus pulp on the Upper Nile. He had some quarto stuff in his possession that had arrived during the previous week and was now being tested and valued. It was an advance sample of what was arriving for the first time in bulk in this country. Of course the deciding question was, What it would cost per ton to import into this country? The first commercial shipment of nineteen tons was due on the following day, and another shipment of thirteen tons was on its way from Port Sudan.

The Hon. Sir John McCall, M.D., LL.D., Agent-General for Tasmania, said he was precluded, owing to the record length of the meeting, from dealing with the question of the possibility of the introduction of the paper-making industry into Tasmania. That State had enormous forest areas, much of the timber of which complied with the condition laid down by Mr. Foster—namely, that it must be cheap. A ton of wood cost 25*s*. in Canada and in Tasmania only 5*s*. In conclusion, he desired to propose a cordial vote of thanks to the author for his excellent paper, and at the same time to express, on behalf of the Committee of the Colonial Section, their thanks to Sir George Perley for having occupied the chair.

Mr. Carmichael Thomas seconded the motion, which was carried unanimously; and Mr. Phillips having briefly acknowledged the compliment, the meeting terminated.

Mr. H. A. Bromley, of H.M. Stationery Office, who was prevented from attending the meeting, wrote:—In view of the very serious depletion of the world's forest resources now going on—largely, unfortunately, to supply a demand for purely ephemeral purposes—and the probable steady increases in the rate of depletion, the question either of husbanding our present resources or of finding satisfactory and economical, as well as competitive, substitutes for wood pulp is becoming a very urgent one. In calling attention to the whole question in what will prove an exceedingly interesting paper, Mr. Phillips will, I am sure, be accorded the interest and support of all the paper-making world.

RAILWAY AND INDUSTRIAL SCHEMES IN CHINA.

In the course of his presidential address to the Engineering Society of China, at their recent meeting in Shanghai, Mr. A. C. Clear, M.Inst.C.E., gave some very interesting particulars of recent engineering developments in China.

National Irrigation and Water Conservation.

One of the first and possibly most striking of the developments which have occurred during the last twelve months is the establishment of a National Irrigation and Water Conservation Bureau at Peking. Until the establishment of this bureau any conservation work required was carried out only with regard to local needs. The result was that much patchwork was done. This became every year more difficult to maintain, and almost inevitably failed at the crucial moment, as the almost annual record of floods has proved. The work of the bureau is to centralise and direct local efforts along the lines of a comprehensive scheme, to secure permanent protection, and also to supplement local effort by Government assistance in the case of large programmes.

The scheme which has been brought most prominently to notice is that of the Hwai River Conservancy. By efficient drainage under this proposal some 17,000 square miles of rich agricultural land will be rendered immune from the devastation caused by constantly recurring floods. Many thousands of human beings now so often rendered homeless and devoid of food will, upon the completion of this work, be able to live in comfortable prosperity. Instead of only two harvests in every five years, which is the present low average, bi-annual crops may be expected. In addition, some two to three thousand square miles of low swampy ground, now valueless, will be reclaimed and put under cultivation, giving abundant support to a considerable community. The large sums now expended in charity will be saved, and a contented revenue-producing people should result, providing from their surplus produce food required for other portions of the Republic. Should the scheme prove a feasible one, there would appear to be little doubt about it being carried out, as its magnitude, from an engineering and philanthropic point of view, is such that it will especially appeal to the Red Cross Society of America, which has undertaken to provide the necessary funds.

The canals and waterways of China and their conservation have been a subject of great interest and admiration to all nations, but that admiration has chiefly centred in the past, as the recent neglect of China's waterways is a subject which hardly bears thinking about. Probably in no other branch of engineering does neglect have such disastrous results as in waterways, and where, as in China, the solid matter held in suspension in the water is so considerable the results are proportionately worse owing to the abnormal silting which takes place.

Conservancy engineering has not always been a decadent profession in China, for more than 4,000 years ago a conservancy engineer was called upon to serve as Emperor, as an appreciation of and reward for the inestimable benefits that he had conferred upon mankind. The records state that "The Great Yu" (as the Engineer-Emperor was called) strenuously opposed the honour thrust upon him. It is satisfactory to note that even in such early ages modesty was an attribute of engineers.

North China Oil Fields.

Another step of considerable importance is the decision of the Government to further the development of the natural resources of the country, as evidenced by the agreement entered into in February, 1914, with the Standard Oil Company for the exploitation of the North China oil fields. These oil fields are stated to be of enormous value, and their opening up should be of great financial benefit to the country. The following figures are instructive in this connection. During 1912 the imports of kerosene oil into China from all sources, America, Sumatra, Borneo, Russia, Burma, and Japan (to put them in order of the importance of supply), exceeded 198,000,000 gallons, of a total value of some *Hk. Tls.* 25,000,000.

One can but regret the aversion to the exploitation of her wealth that has handicapped China in taking the necessary steps to open up this vast natural treasure house, if only to supply her people with what they so evidently need. Through the revenue to be obtained from this source alone the economic changes that may be brought about are considerable. The possibility also of building up the export trade which is required to contribute to the financial stability of the country should convince China of the advisability of removing more of the stumbling-blocks impeding her path towards being one of the wealthiest nations in the world.

The mining regulations promulgated by the Chinese Government during the period under review may be considered as another expression of a desire to take advantage of her resources. Mining regulations have been drawn up in the past at frequent intervals, but never have they so closely approximated to what is needed. They are still not altogether satisfactory, being somewhat arbitrary and incomplete, and give evidence of having been effected by those not fitted fully to appreciate the technicalities of the subject.

According to the most recent statistics available the following are the principal metals imported into China during the year 1912:—

	Piculs.	Hk.Tls.
Iron	2,170,000	7,070,000
Copper	122,000	3,529,000
Tin	235,000	2,950,000
Steel	117,000	1,048,000
Lead	105,000	650,000

16·8 piculs = 1 ton. *Hk.Tls.* 1 = 3*s.* 0¾*d.*

Although comparatively little is known of the mineral resources of China, there is sufficient evidence that the metals enumerated above could be found, and found in abundance. The figures given, totalling some 15½ million taels, are instructive, and should assist in firing the imagination towards fuller development, thus bringing many more millions into China's Treasury.

The Coal Industry and Railways.

Another great industry that with modern methods of machinery will tend towards China's prosperity, and of which there is no doubt as to its value, is coal. The output from mines already open is well over 12,000,000 tons per annum, of about £10,000,000 value, the majority of this being used in the country, as only 680,000 tons were exported in 1912, of a total value of £510,000; during the same year 1,500,000 tons were imported, of a total value of £1,215,000.

With the provision of better means of communication and transport, the resources of the country in this direction are practically unlimited. So far, mining development has been considerably hampered by the action of some of the provincial governments in over-taxation, by the antiquated methods of mining adopted in many instances, by lack of means of transport, but principally by the restrictions placed upon foreign capital, without which it is impossible for the heavy initial expenses to be met.

Improved means of transport must first be given, and as these are now being provided through many coal-bearing areas by railways, we should in the near future see vast expansion. Railways loom largely in the development of the country, and at no period in Chinese history have so many agreements for their construction been completed as during last year.

That actual construction has received a temporary setback owing to the European War does not detract from the evident desire of China to open up the country in all directions. This desire has undoubtedly been strengthened by an appreciation of the advantages that were obtained during the recent revolution in the quick transport of troops and munitions of war. Apart from this, there are now sufficient railways in China to convince the most sceptical of their utility and necessity. It is not intended here to discuss all the railways projected during the year, but only those which appear directly to affect the future of Shanghai and for which agreements have been entered into.

The first in order of signature of agreement is the Pukow-Sinyangchow Railway. This, together with the Shanghai-Nanking, the Shanghai-Hangchow-Ningpo, and the Canton-Hankow railways, was included under a concession obtained by the British and Chinese Corporation in 1898, when a preliminary agreement was entered into, upon the understanding that the final terms should await those of the Shanghai-Nanking Railway, and be drawn up similarly. Then followed a long period of delay: first, the Boxer trouble, next the

South African War, later the Russo-Japanese War influencing this, and it was not until July, 1908, that the Shanghai-Nanking Railway Agreement was signed. It was then decided to construct the Tientsin-Pukow Railway before concluding arrangements for this cross-country line, and not until 1902 were negotiations resumed. The agreement was signed on November 14, 1913. The survey is now nearly complete, and construction work had actually commenced when war for the fourth time in this railway's history has put a temporary stop to further constructional work.

The line starts from Wu-I on the Tientsin-Pukow and connects up with Sinyangchow on the Peking-Hankow Railway, a distance of approximately 260 miles. The country traversed is a rich agricultural district with practically no other means of communication or of transport than that supplied by carts, and China carts on Chinese roads are under the best conditions a slow, unsatisfactory and painful means of transport for goods and for passengers. In addition to the heavy grain traffic which must result from this agricultural district, there are considerable coal deposits existing in the near neighbourhood of the line which may be developed to the benefit of the railway, both for its own fuel supply and as an item of freight. There is every possibility that this railway will affect the future of Shanghai, as it opens up a large tract of practically untouched country, with better means of communication across the Yangtsze at Nanking than those at present existing, and facilities for the handling of goods in bulk; a great deal of traffic should find its way into the local markets of Shanghai.

Another very important line is the Nanking-Nanchang-Hunan Railway, which will connect with the Shanghai-Nanking Railway at Nanking and extend through Nanchang, joining the great Canton-Hankow trunk line either through Pingsiang at Chuchow, or possibly direct with Changsha. The line will traverse Anhwei and Kiangsi, provinces rich in agricultural produce and in minerals, particularly in coal. The agreement for this railway was signed on March 31, 1914, and the preliminary survey work has recently been started. The length of main line is approximately 650 miles. From an engineering point of view this line promises to be full of interest.

Important Junction Line.

One small railway which, amongst its mightier brethren, might easily pass without notice, but will be of considerable local importance, is the junction line at present being surveyed between the Shanghai-Nanking and Hangchow-Ningpo railways. This small junction will overcome some of the disadvantages under which the Shanghai-Hangchow-Ningpo Railway is at present labouring, more particularly with regard to the terminal station at Shanghai. This is badly situated from a commercial point of view.

In view of the fact that the present difficulties attending the transport of goods by this route afford a good illustration of similar difficulties to be overcome in the transport of goods from the interior to the coast, a short recital of these may not be uninteresting. From the Yangtsze, through the Poyang Lake and a magnificent series of waterways, runs one of the great trade routes. Water-borne traffic on this route is interrupted at Yu Shan by a range of hills marking the border line of Kiangsi and Chekiang provinces. These hills necessitate a laborious carry-over of some thirty miles to Chang Shan, where boats are again requisitioned to convey the produce another stage upon its journey down the Tsing Tong River to Hangchow. There the trade route diverges to Soochow, Wusih, Shanghai, and other towns.

The great sea-wall which runs unbrokenly from below Hangchow to the sea, whilst forming a barrier to hold the salt water of the Tsing Tong River in check, obtrudes another obstacle to the transport of water-borne cargo proceeding inland. Goods are therefore once more discharged, and, prior to the building of a railway, were loaded again into boats, which literally fought their way through the narrow canals of the city to the more open waters of the Grand Canal. This passage through the city was still further complicated by boats laden with produce, from the towns previously mentioned, coming in the opposite direction. Knowing the "each man for himself" tactics of the Chinese boatmen and the persistent power of his boathook, the wonder is, not that this short journey through the city of seven miles took one month for its accomplishment, but that it was ever accomplished. To obviate this delay a railway was constructed from Zah Kou on the Tsing Tong River to Kon Sen Chiao on the Grand Canal to serve as a carry-over between the two waterways, and is now very fully occupied in the transport of native goods.

The railway known as the Shanghai-Hangkow-Ningpo Railway was connected with this short "carry-over" piece of line, but owing, as previously stated, to the unfortunate position of the Shanghai terminal station, a very small proportion of the goods traffic is rail-borne to Shanghai. The junction line now being built will tend to remedy this objection by bringing the goods into closer touch with the markets of Shanghai.

A short line similar to that from Zah Kou to Kon Sen Chiao is projected on the borders of Chekiang to take the place of the portage from Yu Shan to Chang Shan, and whilst this would be a great improvement on the existing arrangements —which consist principally of mule transport—the continual transfer of goods from boats to trains and *vice versâ* is objectionable. It is slow, costly, and involves a certain amount of loss and damage to the goods with each handling.

It may be asked, what would happen to the boats should they be displaced by railways on these various trade routes? Mr. Clear gave it as his opinion that they will be better off eventually than they have ever been, as they will act as feeders

to the railways, and instead of doing a few long, laborious trips each year, often under heart-breaking conditions, with interminable delays, many short trips could be made that would pay much better. Such a combination of waterways and railways would result in ideal transport facilities. (When the trams were first projected for Shanghai an outcry was raised on behalf of the rickshaw coolies. The trams have come, are filled to overflowing, and there are many more rickshaws in Shanghai than before.) In the process of development the waste that now ensues through constant delays and inability to transport the produce of one portion of the country to another will be avoided, new industries are springing up, and there should eventually be abundance for all.

Developments at Shanghai.

Let us turn now to Shanghai and see what is being done to meet the changing conditions that will inevitably result with improved and extended means of transport. Shanghai is particularly quoted, but much the same could be said of other ports. The following extract, taken from a recent article published in the *North China Daily News*, is peculiarly appropriate and instructive. It is as follows:—

"During the first three months of 1914, 2,394 houses were under construction, a number far in advance of the record for a similar period, viz., 1,350 in the first three months of 1906. It has been estimated that the number of houses erected in Shanghai during 1914 will reach 9,600, but there are indications that this estimate will be exceeded. Many new buildings are being erected for Shanghai industries, and the work marks a further stage in the progress of the settlement towards becoming a big industrial centre. Considerable additions are being made to the mills in the western district, from the French Concession to the Soochow Creek. A Japanese cotton mill is being built on an extensive site at Tong-King and Macao roads, and will probably give employment to some 3,000 work-people. A larger flour mill is in course of construction in the same neighbourhood, and extensive additions are being made to Messrs. Price's candle factory. Lower down the creek towards Markham Road another large flour mill is being built. These works necessitate the building of a great number of Chinese dwellings in their immediate vicinity. Similar activity will be observed at Yangtszepoo. On the War Road extension new godowns and a laboratory are being constructed for Messrs. Voelkel and Schroeder. The Hwa Sing Cotton Company is building a large mill with godowns and store-rooms, and three mills for the cotton company removing from Hong-Kong to Shanghai are being erected on a site off Wetmore Road. In addition to these, considerable extensions are being made to the Ewo Mill premises, and those of the Laou Kung Mow and Heng Foong cotton companies."

From the foregoing it will be seen that local development is going on apace; the Municipal Council is endeavouring by a revision of the building rules to cope with some of the evils that will result from this present rush in building, which is not altogether a subject for congratulation, as the style and quality of the buildings are far from ideal. Behind the garish fronts of semi-foreign buildings great quantities of flimsy houses are being thrown up for human habitation with scant regard to health or safety from fire or epidemic. The recent pamphlet issued by the Engineering Society of China on reinforced concrete should be of invaluable assistance if the results obtained after a long series of experiments were made to apply to buildings generally in Shanghai.

Traffic problems, also, are probably more difficult in Shanghai than in any other town in the world. Already the streets are well-nigh impassable, often dangerous, and to continue to allow the herding of masses of human beings in restricted areas can only result, in the near future, in costly confusion—costly because of the delays and increased risks to persons and vehicles, in the additional wear and tear of roads, necessitating further obstruction to traffic by more frequent renewals to road surfaces, additional police, etc. Underground transport is not practicable in this low-lying, water-logged soil; overhead would be expensive, nerve racking and impracticable, except in the larger thoroughfares. The only solution would appear to be in the provision of wider roads and the limitation of dwelling-houses, particularly in the business quarters. One is tempted strongly to urge a more public spirit than is often displayed in assisting the council to fulfil its difficult obligations in bringing about necessary reforms.

THE DEVELOPMENT OF THE TEXTILE INDUSTRIES.

Export Trading.—The announcement of the official desire to do nothing needlessly to obstruct export trading has been gratefully received in textile quarters. In an ordinary year approximately half the export of British manufactures consists of textile goods. Textiles form two-fifths of British exports of all descriptions, and in a time when it is peculiarly important to reduce the adverse trade balance, textile exports deserve especially favourable consideration. It is perhaps none too widely appreciated that the lines of business which allow of the largest and quickest expansion are precisely those in which a large turnover is already done. Those associated with the greater industries of the country have a long-standing acquaintance with the fallacy which assumes that the converse is the case, and that the largest potentialities lie in the neglected and minor opportunities. Transactions in large amounts are evidently wanted in the interests of national finance, and textile export business is distinctively an affair of large amounts. Export is hampered at present by restrictions

which aim at the prevention of supply to enemies, or, in some cases, at the maintenance of a sufficient supply for home needs. The necessity for carefulness in these matters is everywhere admitted, but there are, of course, complaints. Hard cases occur whenever an arbitrary line is drawn, and some have been reported. In all matters necessitating particular inquiry there is delay, and objectionably long waits have had to be borne. For obscure but doubtless valid reasons there have been sudden reversals of official policy, disturbing to traders who thought themselves in safe grooves. Then there have descended upon exporters new edicts issued without warning, and suspected of containing within themselves further seeds of trouble. The upsets have been borne with a calmness that could not have been mustered twelve months ago, but they create a tension which makes the assurances conveyed in the Budget speech especially welcome.

Technical Progress.—The resources of the textile machinists have been laid under contribution by the military authorities, with the consequence that parts of small-arms and other munitions are being made in the works usually devoted to new spindles and looms. More or less, all the makers of mill supplies are busied in one way or another with war materials, and the part played by textile manufacturers in the same connection is already well known. In the circumstances, technical progress cannot be said to be at an end, but its achievements are unobtrusive. The new efforts are not on virgin ground, and aim principally at making goods that somebody else has made before. There is a lull in new discovery, but the world is none the less changing, and the losers from contemporary changes have their wits hard at work. The broad character of some of the goods that will henceforth be wanted more largely can be fairly accurately foretold, and some considerable interest is being taken in alternative methods of working. The spirit of speculative enterprise is anything but dead, and, for the time being, readjustments have more practical moment than new discovery.

The Textile Institute.—Preoccupation with the war gives a sufficient reason for cutting down the spring meeting of the Textile Institute to a one-day sitting. The valedictory address of Sir William E. B. Priestley, M.P., the retiring president, occupied much of the morning session, and an informal address from his successor, Sir William Mather, filled the rest of the time. The head of Mather and Platt, Ltd., makers of so many forms of finishing machinery, is at once a magnate of the textile world and a leader of engineering whose long and world-wide experience ought to be remarkably valuable. The technical papers read were two, including one upon the automatic loom by a member who is himself a builder of looms of the ordinary and the automatic types. In treating of the relative commercial efficiency of the respective machines, Mr. Oscar S. Hall was nothing if not impartial. While his conclusions are far from deciding between the rival claims, they do at least help the observer to appreciate the complexities of the problem.

The Efficiency of Looms.—It is apparent that the advantage offered by any machine is conditioned by the circumstances of its use, which are not the same in all districts or countries. Thus for local causes it may pay handsomely to use in Massachusetts a machine that is not lucrative in Lancashire. The automatic loom, so called because of the arrangements for self-replenishment with weft, is a comparatively expensive contrivance which has to be judged upon its commercial merits. It saves labour, but, in order to make the saving large, certain concessions have to be allowed in its favour. It must be fed with good material, often costing more than yarn that can be satisfactorily woven in the old loom. It must be run slower than the ordinary type, usually about 15 per cent. slower, and the best weavers are needed to work it. The weaver can attend many more automatic than ordinary looms; but the saving does not in all circumstances leave a profit. As is sufficiently shown by the huge preponderance of ordinary looms in use in Lancashire, the old machine is a tough one to beat. Mr. Hall propounded a suggestion that the position of the old loom might be further fortified, and that with stronger weft, lower speed, better weavers and more looms per weaver, it would be made more difficult to oust. The suggestion is one rather for proofs than comments, but it may be observed that the 240-pick cotton loom did not spring into existence fully armed. Looms in past times were run slower than now, and their higher speeding is some sort of proof that the increase was not uneconomical. While it is nothing new for manufacturers to forego small advantages in order to possess themselves of greater ones, there is a certain novelty in Mr. Hall's very thoroughgoing proposition. The experiment is one not difficult to carry out by those owning machines of both types.

American Experience.—The reports in the Miscellaneous Series issued by the Department of Commerce, Washington, although little known in this country, provide matter of interest to observers of contemporary industrial history. They are the work of special agents of the Bureau of Foreign and Domestic Commerce relating to affairs as they present themselves to their eyes, and the scope of the inquiry determines whether they exhibit more than one side of the case. A short paper, "Industrial Conditions

in Montgomery County, Pennsylvania," recites some of the troubles of small manufacturers, without going far beyond their point of view. They have grievances against trade buyers who give out contracts and then refuse to respect them if the market falls. They have a legal remedy but hesitate to take it, for fear of losing further business and of establishing a bad name. They complain also of a system going by the name of "protection," which secures the buyer against any rise in the market between the making of the contract and the date of delivery, and provides that he shall have the benefit of any fall. The complainants are manufacturers of woollen goods and hosiery, and Pennsylvanian makers of hosiery are aggrieved by a form of competition which made itself obnoxious in England at one period. They have to compete with men of no mentionable capital and no business experience, who run their concerns usually at a loss. The conditions are unfavourable, but obviously do not prevent larger and more successful undertakings from springing up, and indeed, one American maker of stockings, whose goods sell in the English market, is credited with a turnover of £1,400,000 a year. Had the report dealt with all sides of the case, it might have been acknowledged that in most divisions of the American textile business contracts are lax. In the last resort these obligations are reciprocal, and the buyer who does not accept finds himself dealing with a supplier who does not deliver, unless it suits his purpose to deliver. The big contract that is placed for the season is talked about and advertised, but hardly believed in by anybody. The recipient uses his judgment upon it, and instead of buying materials to cover it fully buys as much as he thinks the customer will actually take. This laxity is not better than the English firmness, although the results may come to much the same in the end. The explanation of the difference in practice can perhaps be sought in the difference of national temperament. After all, it is not a new discovery that the American customer either wants to buy more than one is inclined to sell, or is opposed to buying anything.

Sewing Silk.—The making of silk sewing-twist by hand survives in Staffordshire, and competent judges recognise in it merits higher than those in twist made by machine. The greater part of the silk thread used for sewing is palpably not neat silk but spun-waste silk, good qualities of which are spun expressly for the Leek trade. Silk sewing-thread is the article prescribed for the seams of army uniforms, and it is apparent that quantities of it have been used by the clothing contractors. On the other hand, members of the Silk Association are not satisfied that cotton has not been used by some sub-contractors, and the attention of the responsible authorities has been directed to this point. The natural increase in the use of silk for sewing has obviously been checked by the introduction of mercerised cotton, and while consumption for this purpose has only a limited importance in respect of quantity the principle involved is a considerable one.

CORRESPONDENCE.

HOUSE-FLIES AND DISEASE.

While an exhibition of apparatus and inventions for the destruction of house-flies and their breeding-places is being held in London, it seems a not inappropriate time to refer to a suggestion of mine which was published in the *Journal* of March 27th, 1914.

The said suggestion was for the exclusion of house-flies from dwellings, and especially from hospitals, for the feasibility of which I gave grounds from my own experience.

At the present time, when wounded and sick men are crowding all available hospitals at the front, the bases, and at home, it seems urgently important that steps should be taken immediately to exclude flies from all hospitals, but especially from those for the wounded, who in many cases are incapable of using their hands to keep the flies out of their eyes.

H. T. Geoghegan.

THE DESIGN AND INDUSTRIES EXHIBITION AT GOLDSMITHS' HALL.

I have to-day had my attention called to an article in the *Journal* of April 9th, regarding the exhibition at Goldsmiths' Hall and the Design and Industries Association.

As a member of the committee I feel that the writer was hardly fair in some of his criticisms, especially seeing the difficulties under which we had to get our little selection of goods together.

It is admitted by those who have seen much of Germany during the last five years that the development of art applied to industry has been little short of astounding. The movement fostered by the Werkbund not only covered fabrics, pottery, printing and articles of everyday use, but all forms of engineering and building, aiming primarily at fitness for use and quality work—the two cries of modern German movement. I should like to recommend your writer to study the last three illustrated year-books of that Society.

Your writer says "the authors of this appeal are artists, they naturally see that the manufacturers have been at fault." This statement is wrong. I certainly cannot claim to be an artist, and the very reason that made me join the committee was that I have found the German capturing the cane trade of the world through intelligent co-operation between designer, trade school and manufacturer, and that I was only able to fight this by using the

same methods. Another of our committee is head of a large furnishing store, a third a furnishing decorator, a fourth an architect, the other three being connected with printing, lithography, and jewellery, both practically and as teachers.

When I see in my own trade, winter by winter large numbers of people on short time while the German has the whole of the export market because of his intelligent use of the artist and trade school, I must say that I feel that every effort in trying to get that same co-operation in this country should receive the whole-hearted support of everyone interested in national welfare.

If your writer will be good enough to get a little more into touch with the Design and Industries Association I think he will see how he has misunderstood our aims.

HARRY PEACH.

Dryad Cane and Metal Works,
St. Nicholas Street, Leicester
May 14th, 1915.

The writer of the article, to whom the foregoing letter has been submitted, replies:—

I regret that my article appears unduly severe to Mr. Peach, but may I be allowed to point out that he seems to have somewhat misunderstood both it and my attitude towards the Design and Industries Association? With the aims of that Association I am in hearty sympathy, and I have already taken steps to put myself in touch with it; but I have seen too much of the working of the Arts and Crafts movement in this country not to feel the necessity for uttering a word of warning.

I am afraid that I cannot claim any knowledge of the cane furniture trade (though I know and appreciate the articles turned out by the Dryad Works), but I have kept in touch with what Germany has been doing in other industries, and I am not convinced that the success of her export trade has been due more to the artistic quality of her work than to its cheapness. That is not an argument against any attempt to improve the taste of our own output, but it is one against expecting an immediate and remunerative response on any very large scale to the efforts which may be made.

Again, if your correspondent will refer to my article, he will see that in the quotation which I made from "Design and Industry" the world at large is divided into three classes—designers, manufacturers, and the purchasing public. I was not aware that Mr. Peach was a manufacturer, and I am sorry that I put him into the wrong compartment; but I think that even on his own showing the other members of his committee do not, for the most part—in such a classification—come under the heading of either manufacturers or the purchasing public. Perhaps as a manufacturer he has been accustomed to use the word "artist" in a more limited sense than is possible to anyone who has always been in close touch with artistic craftsmen.

NOTES ON BOOKS.

VILLAGE AND TOWN LIFE IN CHINA. By Y. K. Leong, LL.B., B.Sc. (Econ.), and L. K. Tao, B.Sc. (Econ.). London: George Allen & Unwin, Ltd. 5*s*. net.

For all students of sociology this book possesses very considerable interest. It is a work about certain aspects of life in China by two Chinese students, who, while they have been familiar from their birth with what they describe, have also been for some years students at the London School of Economics and have thereby been enabled to apply themselves with quite unusual opportunities to the comparative study of widely differing social institutions.

The first part, which is by Mr. Leong, describes the village life—the family, the clan and the village society. Mr. Tao's section deals with town administration and social life, and with the popular side of Chinese Buddhism. In both we see the family as the great unit, including the ancestors, all the living kindred, and the unborn members who are to perpetuate the memory of their forefathers. The real China emerges not as a despotism, but as a great aggregate of democratic communities, governing their affairs through the heads of families. The authors throw a good deal of new light on the real meaning of this family life. They emphasise its ethical value, and the spirit of self-sacrifice on which it is founded; and they also point out how much it has done practically to provide for the old, the poor and the helpless.

One of the most interesting points dealt with in the book is the position of woman in China. According to these writers, she really holds a position of authority and respect, qualified only by a technical inferiority of position. If the education of Chinese girls (as we understand the word) usually ceases at an earlier age than that of the boys, it is because the Chinese consider their special training better adapted to the potential mothers of families. A Chinese girl can manage a family at an age when a Western girl is still at school. If her powers of reading and writing are small, it does not follow that her knowledge of literature is limited. It is a common recreation for women to listen, as they work at embroidery, weaving and so forth, to minstrels who sing them the classics of Chinese poetry, romances, legends and chronicles, "and very often when no minstrels are at hand they each sing in turn, and all from memory. As they generally cannot read, their powers of memory are marvellously developed. It is quite an ordinary thing for a girl to repeat from memory word for word a poetical legend of several thousand lines after having heard it but several times. I wonder whether an average factory girl in England would be able to recite off-hand a stanza from Shakespeare or any other poet."

For a system of education which gives such results as these there must be a good deal to be said; but one may, perhaps, be permitted to doubt some of its advantages when one learns that "on the marriage or death of relatives and friends she has to recite extempore appropriate verses of her own on such subjects as the sorrows and joys of life, the virtues of filial piety, friendship, and so on." Unless on these occasions she can borrow very freely from her memory of the classic poets, it is to be feared that her efforts will prove somewhat tedious.

LITHOGRAPHY AND LITHOGRAPHERS. Some Chapters in the History of the Art by Elizabeth Robins Pennell, together with Descriptions and Technical Explanations of Modern Artistic Methods by Joseph Pennell, President of the Senefelder Club. London: T. Fisher Unwin. 10*s.* 6*d.* net.

The art of lithography was invented by Aloys Senefelder in 1798. In 1819 the Society of Arts awarded him a gold medal "for having freely communicated to the public the most perfect and complete account of the whole process of Lithography, of which he is the inventor." Mr. and Mrs. Pennell put it on record that the gold medal was promptly pawned, but Senefelder must have appreciated the Society's recognition more than this action might seem to indicate, for he presented them with one of his printing presses in acknowledgment of their award. It is seldom that the early history of an invention can be so shortly and so certainly stated. There have been others who tried to get credit for the invention, but the researches of Mr. and Mrs. Pennell have established the claims of Senefelder beyond any shadow of doubt whatever.

The first part of this book, which deals with the history of the art, is the work of Mrs. Pennell. It is founded on the well-known book of the same authors, which was issued in 1898, and has long been out of print; but it contains a great deal of fresh material, and has been entirely rewritten. Much of the information contained in it was embodied in the admirable course of Cantor Lectures on Lithography which Mr. Pennell delivered before the Royal Society of Arts last year, but, of course, the book is very much fuller and more complete in every way.

The second part of the book, which is the work of Mr. Pennell, is entirely new. It explains in a singularly lucid way the various technical processes in the art of lithography. For many years lithography was wrapped in mystery, and secret processes were the rule, but here all is explained by Mr. Pennell, and there is found to be no black magic about it. "Now that we have solved these mysteries," he says, "we find they were mostly made up of lemon-juice, labour leagues, stale beer, and hide-bound stupidity, and we have either found out the secrets, or other printers, other methods, or set up presses of our own."

There can be no doubt of the enormous gain to lithography from these modern, enlightened methods. After languishing in an almost moribund condition for some thirty years, the art began to revive at the opening of this century, and each year sees steady and enormous improvement. At the present moment many of our finest artists work in lithography, and the wonderful changes which the last few years have shown on our advertisement hoardings are the fruit of this development. Probably no one has been to a larger extent responsible for this advance than Mr. Pennell. An enthusiastic lithographer himself, he has shown what the art can do in the hands of an artist, and the Senefelder Club, of which he is the president and the ruling spirit, is rapidly teaching the world to appreciate the possibilities of lithography. There can be no doubt that this book, which is extremely readable and lavishly illustrated with reproductions of a very large number of lithographs, will do much to foster the interest in what can be, and ought to be, a highly artistic art.

VALUATIONS. By Samuel Skrimshire, F.S.I. London: E. & F. N. Spon, Ltd. 10*s.* 6*d.* net.

This text-book deals with valuation as applied to the sale of property (freehold, lifehold, copyhold, and leasehold), assessments to duties under the Finance (1909-10) Act, the enfranchisement of copyhold estate, assessments for rating purposes, compensation on compulsory purchase, and valuations for advances on mortgage. The subject is a very complicated one, and there is practically no limit to the knowledge which an expert valuer ought to possess. He certainly should be well-informed on such points as building and sanitation; he may well be required to estimate the value of timber growing on a property, or of minerals which may lie beneath it; he must know the value of neighbouring properties, and in many branches of law he must have an expert's knowledge. It is obvious that no single book could deal with all the subjects on which a valuer may be called upon to give an opinion, but as regards those which are laid down by the Surveyors' Institution for examinations which their members must pass, this volume should prove a very useful guide. It is clear and succinct, and the large number of practical examples which are worked out for the student should enable him to obtain a firm grasp of the various complicated problems presented to him.

GENERAL NOTES.

TRANSFERRING WORKERS TO A NEW TRADE.—An article in the *British Review* records an interesting experiment recently made at Toynbee Hall "to take mature men, mostly over the age of forty, and teach them a new trade." The

furniture trade, being hard hit by the war, was suffering from a glut of workers. The leather trade was experiencing an unprecedented scarcity of hands, owing to the insatiable demand for leather stitchers for military accoutrement work for the British, French, and Russian Governments. Some of the residents at Toynbee Hall hit on the brilliant idea of deliberately transferring men from one trade to the other. The Prince of Wales's Fund produced the money needed to equip the school and maintain the scholars, and the school was opened on December 7th. It was a venture of faith, but faith was more than justified. Out of 139 scholars enrolled up to January 15th, only two men were sent away from the school because of their inability to learn a new trade, and fifteen left because they had got work at their old trade. Every man who has had a full month's training at the school has found work, while some of the men have got good regular work after a fortnight. The average wages earned by the men who have found work are between 30*s.* and 35*s.* Some are earning £2 a week, and a few as much as £3.

Proposed Military Academy at Quetta.—The *Civil and Military Gazette* understands that the Government of India propose to establish shortly a military academy at Quetta, to be founded very largely on the lines of the Royal Military College at Sandhurst. A number of young officers have arrived, or are arriving, in India for appointment to the Indian Army after passing the qualifying examination at home. These young officers will be called on to pass a further examination at the end of six months, which period they will pass at Quetta, at the above military college, where they will learn their duties and generally qualify themselves for employment in the Indian Army. The details of the scheme and the staffing of the college are now engaging the attention of the military authorities.

Industrial Activity in Switzerland.—There appears to be considerable activity in many branches of industry, at the present time, especially in the canton of Soleure. The metallurgical establishments are working overtime in consequence of the numerous orders which are coming in from abroad. At Olten, the boot and shoe factories, as well as the motor-car factories, are in full work. The watchmaking industry, which last summer was nearly at a standstill, has now resumed its former activity, in consequence of the numerous foreign orders which are coming in daily.

Traffic on the Suez Canal in War Time.—The statistics published by the Suez Canal Company for 1914, whilst showing an increase of nearly 2 million francs (£80,000) in the receipts for the first half year, indicate a decrease of about 6 million francs (£240,000) in those of the second half-year's workings. As compared with 1913, this shows a falling off of 4 million francs (£160,000). This, on a total of 121 million francs (£4,840,000) annually, is not very considerable, but it must be taken into consideration that the receipts of 1912 had already shown a decline of 12½ million francs (half a million sterling) against those of the previous year. The transit of the troopships from India *viâ* the Canal last autumn no doubt prevented the receipts from falling lower. It is to be feared that, judging from the decline in the tonnage that passed through the Canal last January, a still further decline in the traffic returns may be anticipated during the present half year.

MEETINGS FOR THE ENSUING WEEK.

Tuesday, May 25...Royal Institution, Albemarle-street, W., 3 p.m. Dr. M. O. Forster, "Colouring Matters of the Organic World. Lecture II.—Dyes: the Creation of the Chemist."

Zoological Society, Regent's Park, N.W., 5.30 p.m. 1. Mr. R. I. Pocock, (*a*) Exhibition of pieces of Wild Boar skin; (*b*) Exhibition showing evolution of Porcupines' quills. 2. Mr. S. Hirst, "On a Blood-sucking Gamasid Mite parasitic on Couper's Snake." 3. Mr. G. A. Boulenger, "A List of the Snakes of Madagascar, Comoro, Mascarenes, and Seychelles." 4. Dr. P. Chalmers Mitchell, "Anatomical Notes on the Gruiform Birds *Aramus giganteus* Bonap. and *Rhinochetus kagu.*"

Wednesday, May 26...Literature, Royal Society of, 20, Hanover-square, W., 5 p.m. The Very Rev. the Dean of St. Paul's, "English Religious Poetry."

Thursday, May 27...Electrical Engineers, Institution of, Victoria-embankment, W.C., 8 p.m. Annual General Meeting. Review of the work of the Session by the President.

Friday, May 28...Petroleum Technologists, Institution of, at the Royal Society of Arts, John-street, Adelphi, W.C., 8 p.m. Mr. H. Barringer, "The Evolution of the Oil-Tank Ship."

Royal Institution, Albemarle-street, W., 9 p.m. Sir John Jackson, "Engineering Problems of Mesopotamia and Euphrates Valley."

Sanitary Institute, Guildhall, Shrewsbury, 7.30 p.m. Dr. T. Orr, "The Value of Mechanical Filters in the Purification of Water."

Physical Society, Imperial College of Science, South Kensington, S.W., 5 p.m.

Saturday, May 29...Linnean Society, Burlington House, W., 3 p.m. Anniversary Meeting.

Royal Institution, Albemarle-street, W., 3 p.m. Professor R. S. Rait, "Mary, Queen of Scots." (Lecture I.)

Correction.—Mr. Charles R. Darling asks that the following correction be made in his paper on "Recent Progress in Pyrometry," which was reported in the last issue of the *Journal*: The pyrometer described as "Becker's" on pp. 597, 598 and 599 of the *Journal* was designed in the Research Laboratory of the Rudge-Whitworth Company, Coventry, and should have been designated the "Rudge-Whitworth Pyrometer."

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FRIDAY, MAY 28, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

A meeting of the Indian Section was held on Thursday, May 13th, 1915; The Most Hon. the Marquess of Crewe, K.G., P.C., Secretary of State for India, in the chair.

The Chairman, in introducing the reader of the paper, said Sir Charles Armstrong's experience enabled him to deal to the fullest extent with the subject of the paper. Sir Charles had had a long experience in India, dating from the year 1885. During that time Sir Charles had filled many prominent offices in connection with different activities in Bombay, culminating in the extremely important Chairmanship of the Chamber of Commerce of that mighty commercial centre. Those facts alone would entitle Sir Charles to speak on the subject of the paper, but, in addition, Sir Charles had been for a considerable period a member of the Legislative Council in the Presidency of Bombay, and for a somewhat shorter period a member of the Viceroy's Legislative Council. That double distinction was of importance in the following respect: India was so vast and so various, that those who were only acquainted with the circumstances of one division of the Indian Empire were at any rate liable, as the phrase went, "not to see the wood for the trees." On the other hand, those, fewer in number, who had only had the opportunity of examining India from the centre, were likely to fall into the opposite defect—to be so much impressed by the magnitude of the area of the forest as not to pay due attention to the precise vegetation of which it was composed. From either of these temptations a man like Sir Charles Armstrong, who had served in the Legislative Council both of a Presidency and of the central Government, was likely to be secure.

The paper read was—

INDIAN TRADE AND THE WAR.

By Sir Charles H. Armstrong,

Late Chairman of the Bombay Chamber of Commerce.

My paper this afternoon is on "Indian Trade and the War," and, so far as Indian trade is concerned, a great deal of much interest could, no doubt, be said; but as my time is limited I will not attempt too much, and will only, therefore, touch very briefly on the early history of India's external or foreign trade, so that I may be able to deal at greater length with the trade conditions of the present day. I shall then have something to say about the railways in India—their administration and so forth—and later on, towards the end of the paper, I shall refer to the effects of this great and terrible war on the sea-borne or foreign trade of the country. I trust that in the course of my remarks I shall be able to convey to you a correct impression of the vastness of India's oversea trade and of its great importance to the markets of the world, for India is a keen buyer or seller—and sometimes both—in all great commercial centres. As we proceed, you will see how rapidly the sea-borne trade has increased in recent years, the reasons for this increase, and the great possibilities of the future.

With these few introductory remarks I will now proceed to the reading of my paper, which I trust will be found interesting, but the subject is not one that lends itself to very attractive treatment.

We may, I think, accept as a fact without comment that India's internal trade must always have been of considerable importance, although hampered in early days by many difficulties and restrictions, but the foreign or sea-borne trade has only become of great value in comparatively recent years. In very early days there was a land connection between the Caspian or Black Sea and the western districts of Hindustan; but in the seventh century B.C. a sea trade sprang up between the Persian Gulf and India, and from the head of the Gulf caravans carried supplies into Syria and Egypt. Later on, in about the first century A.D., the Red Sea route was developed, and by slow degrees the trade spread gradually into Eastern Europe. With the arrival of the Portuguese in Southern India in the fifteenth century the

foreign trade was organised and developed, and regular shipments were made to Antwerp—at that time the commercial centre of Europe. Towards the end of the sixteenth century, an English company began to trade with India, and in the year 1600, or only a little over 300 years ago, the first English East India Company was founded. The foreign trade at that time, and for some time later, was very small, and it was not until the end of the eighteenth century that the shipments increased to a considerable extent. The difficulties that had to be contended with in those days were the long sea journey to Europe *viâ* the Cape and the great difficulty of bringing produce down to the coast from the interior of the country, as there were no railways, and the means of transport, excepting where there were navigable rivers, were very primitive. At the time of the Mutiny, or, say, fifty-eight years ago, there were only about 270 miles of railways in India, one section being under construction inland from Calcutta and another from Bombay, and it was largely due to the difficulties then encountered that a development of the Indian railway system was brought about. The great event for India, so far as its foreign trade is concerned, was, however, the opening of the Suez Canal in 1869, which reduced the voyage to Bombay from 100 days or more to about twenty-five days, and this great change brought about a most striking development in trade.

Now, in dealing with this subject it is necessary to bear in mind that India will always be mainly an agricultural country, and that the prosperity of the people will depend upon the annual rainfall. It must be very difficult for those who have never been in the East to realise the supreme importance to the country of the monsoon rainfall, which sets in on the western coast at the end of May or early in June, and, after spreading rapidly nearly all over the country, continues in these parts until the end of September, and in some parts—more particularly on the Madras coast—until about the end of the year. In addition to the south-west and north-east monsoons, to which I have just referred, there are, in Northern India, the cold-weather rains in January and February—only a few inches it is true, but sufficient, nevertheless, to produce some of India's most valuable crops on which the prosperity of the sea-borne trade very largely depends. The drawing up of the Indian Budget, which is presented to the Imperial Legislative Council in Delhi early in March was described only a few years ago by the Financial Member as being a "gamble in rain," and it can well, therefore, be understood that the coming of the monsoon in June, and its progress during the four months June to September, is anxiously watched, not only by the officials of Government, but by the commercial community and the agriculturists whose livelihood and prosperity depend on a successful harvesting of the crops. Before the advent of the rains the country is parched and dry, and the cattle in many districts have to seek for water at long distances. With the coming of the monsoon, however, and the commencement is generally very heavy—I have known, for instance, 24 in. of rain to fall in Bombay in three days—conditions change very rapidly; the country is covered with new grass, and there is any amount of water in the fields, tanks and wells. In about five months the first crops are reaped, and preparations in many parts of the country are made about this time for sowing the winter crops in the damp land, and these mature in the early months of the year. A bountiful rainfall is of inestimable value, but an absolutely perfect monsoon is very rare, and although in my long experience of thirty years I can remember many good monsoons, I can only call to mind one that was really perfect, and that was two years ago, in 1913, when magnificent crops were reaped on all sides. A difficulty in India is that, whereas some crops thrive best with a light or moderate rainfall, others require a fairly heavy downpour, and it is rarely that the fall in the different districts is just sufficient—neither too much nor too little—for the needs of agriculture. It has been said that a few inches of rain, if properly distributed, will produce a perfect cotton crop, but this would not, by any means, be sufficient for the food grains grown in the monsoon, which are used mainly for feeding the people of India. There can be no doubt, however, that, apart from trade matters, bountiful crops are of the greatest value to India, for when there is ample work for everybody, when wages rule high, and when food grains are cheap, the people are prosperous, happy, and contented; whereas, when the reverse is the case, there is poverty and discontent, and this leads to trouble of various kinds, and makes the people more ready to believe that the Government are responsible in some way for their troubles, and it sometimes leads them to take steps to ventilate their grievances. A famine in India on a large scale is always very awful, and after the monsoons there is often, in some part of the country, an area of scarcity

where provision has to be made by relief works and in other ways to provide for the people until the coming of the next rains, which is, of course, many months ahead. There have been several severe famines during my time in India, but one of the worst was not so much a food famine—for now the country has been opened up by railways, supplies of food can be rapidly imported into a distressed area—but a scarcity of water on a large scale due to a very short and absolutely deficient rainfall. This failure of the monsoon caused the most acute misery during the hot weather months, and although everything was done that could be done, many lives were lost and the cattle died also or had to be slaughtered in very large numbers. The conditions, however, under which a food famine is now dealt with are very different from those which used to prevail, for in the great Madras famine of 1876, when many millions of people died, there was an ample supply of rice in the city of Madras, which had been imported from Burma, and there was also a surplus stock available from the Central Provinces, but these supplies, to a great extent, could not be distributed in the districts of the Madras Presidency owing to insufficient means of transport, and in many cases, even when they did reach the starving people it was found, unfortunately, that in their weakened state they could not digest a rice they had not been accustomed to. The extension of railways in recent years has, however, greatly improved matters, and although from time to time there will always be famines in various parts of the country, the loss of life is never likely to be anything like what it was, for the Government system of immediate relief has now been organised on sound lines, and the effects on trade, although serious, will never be felt to the same extent as in the past.

The chief exportable crops produced in India are jute and tea in the east, *i.e.*, on the Bengal side; cotton in various parts of the country, but mainly on the Bombay or western side of India; rice in many districts over an area of 76,000,000 acres; wheat mainly in Northern and Central India; and oilseeds of various kinds, the principal being linseed, rapeseed, cotton-seed, and castor-seed. The export of raw and also of manufactured jute—for Calcutta has many mills working up the raw material into gunny bags and cloth—is the largest foreign trade, but raw cotton is also a very valuable crop, and one that is likely to increase steadily in value and in quantity. The exports of wheat vary with the seasons, and with the demand for Indian supplies from the markets of the world—this country, amongst others, being a large buyer. In the production of jute India is fortunate in having a monopoly of supply, and in tea also her position is a very strong one, but in the other articles I have referred to the prices India is able to obtain in distant markets are regulated to a great extent by the supplies obtainable from other countries—mainly from North and South America and from Canada—and the money received in return is governed, therefore, by what are known as "world's prices." In cotton, for instance, the export price is regulated to a great extent by the crop grown in the United States of America, which is the world's bumper crop, and the ryot or agriculturist in India receives, therefore, varying prices for the produce of the soil according to the position of the world's markets. The monsoon of 1913, to which I have already referred, produced the finest cotton crop, not only in quantity but in quality, that India had ever grown (in quantity it may, however, be exceeded this year), and, most fortunately, satisfactory prices were realised for it. The demand for Indian cotton comes from various countries. Japan is a large and persistent buyer for her mills, and several countries in Europe take also very large quantities—notably Germany, Austria, France, and Italy.

For many years, although it is some time ago, Lancashire—the great centre in this country of cotton spinning and weaving—was a good buyer of Indian cotton, the shipments in the early seventies having been over 1¼ million bales, or more than one-half the total crop; but from this date, owing to the superior attraction of supplies from America, the trade fell off very rapidly, until in 1911–12 the Indian shipments to the United Kingdom were only 50,000 bales out of a total crop of over four millions. Since then, however, the trade has revived a little, and it is possible that importations into this country will increase in the near future. The growth of the cotton-mill industry in India has, however, checked to some extent the exports of the raw material, as just over two million bales are required for this purpose in the country itself, and as Japan is also a very keen buyer the trade to Europe is, perhaps, inclined to fall off. In the year ending June 30th, 1912, the shipments to the United Kingdom and to the Continent dropped to 736,000 bales against a total exportation from all India of 1,828,000 bales.

This, however, was an exceptionally low figure to Europe—about 50 per cent. less, in fact, than in the previous year, when from the port of Bombay alone over a million bales were shipped to this country and to the Continent, the total shipments from all ports having been 1½ million bales. Japan has become a great competitor in recent years, and as the mills in India will absorb increasing quantities, there will not, in future, be as much available for export to Europe, unless the crop can be materially increased. An increase in the area under cotton, which is now 24½ million acres, and a further increase in the yield per acre, are questions which have been prominently before the Government of India and the commercial community for some time past, and steps have lately been taken by seed selection and in other ways to improve the type of cotton grown and to add to the yield. Some success has already been achieved, and if the Government of India will steadily persevere in their efforts, and this they are likely to do, their reward is certain to come in time, although progress at first may be rather slow. If Lancashire can be induced to interest itself again in supplies from India, and it looks very much as if a satisfactory start in this direction has already been made, there is a great opening for increased trade; but quality or length of staple is an important factor, and this is a question which will always have to be kept well to the front. But even if this country does not become an active buyer, there will always be eager markets for all the cotton India can produce, and with the growth of the Indian mill industry there may be less available for the markets of the world. The question of cotton cultivation and of the improvement of the staple is an extremely important one, which should not be lost sight of. As for raw jute, Calcutta, as I have said, has a monopoly, and the trade, consequently, is a prosperous one. Indian tea is, of course, well known and much appreciated in this country, although, personally, I prefer Ceylon; but the trade is a growing one, and at the present time is very profitable. Calcutta is indeed fortunate in having two such valuable crops. The wheat area is immense, about 30 million acres—this year over 32 millions—and the outturn roughly speaking is 10 million tons; but only a small part of this, 12 to 15 per cent., and less when the crop is smaller, is available for shipment to foreign ports, the remainder being consumed or stored in the country. The excess supply, however, is very valuable, and the go-ahead port of Karachi is the principal place of export.

There are, as I have already mentioned, other important exports, for instance: cotton goods and yarns, which go mainly to China, the Persian Gulf, and other adjacent markets; wool, mainly from Karachi; manganese ore, chiefly from Bombay (a growing trade, although under a cloud at the moment owing to the war), and many other articles of considerable amount, which in 1913–14, when added together, gave a total value, including a small amount of re-exports of foreign goods, of £166,000,000 sterling, against a quinquennial average 1864–5 to 1868–9 of 54¾ millions, and in the year 1904–5 of 105 millions; so you will see the trade is growing steadily and is certain to increase. This huge export trade brings with it a corresponding increase in imports, the principal articles being cotton manufactures of all kinds, which come almost entirely from this country and were valued last year at over 44 millions sterling; metals and metalwork of various kinds; sugar, of which the people of India are very fond; railway plant and rolling-stock; machinery, oils, and many other articles of great importance, which in 1913–14, when added together, gave a total value, including Government stores, of 128 millions sterling. The growth of the import trade has also been very satisfactory, the figure I have just named comparing with an average of £30 millions in the five years 1864–5 to 1868–69, and with £70 millions in 1904–05. There is immense scope in India for an increased trade in imports, and as the foreign export trade expands the demand for manufactured goods from this country must also increase. Wealth is steadily, if not rapidly, accumulating in India, for the people are frugal in their habits, and, generally speaking, are content with very little; but even so, as their wealth increases their needs also increase, and an extra dhooty or sarrie is always a welcome addition to their scanty stock of clothing. The average wage for the bulk of the people is small, very small indeed when judged by our standards; but as their wants are few nearly everyone has something to fall back upon, either in the shape of land, jewellery or buried coin. I do not say that this amounts to much individually, although the women folk in many parts of the country are covered with silver bangles on their arms and legs, in their ears, and sometimes through the nose; but in the aggregate it comes to a large sum, and throughout the country there is, therefore, an

immense amount of unproductive wealth. To get at these hoards, and to bring this hidden treasure into profitable use is one of the great problems of the present day, and there are signs in quite recent years that the efforts now being made in this direction are not altogether in vain.

From the figures I have given you will have seen that the balance of trade, *i.e.*, the excess of exports over imports, is greatly in India's favour, and the account is partly squared by large imports of the precious metals, gold and silver in the shape of sovereigns and bars, a large part of the silver being often for coinage into rupees, which is the standard coin of the country and is worth, when measured in gold, sixteen pence against an actual value of metal of something much nearer a shilling. The currency system of India is, however, on a sound basis, and later on I shall have something to say regarding it, but this remark of mine must not be understood as passing judgment or as referring in any way to the controversial questions raised before the Finance and Currency Commission which sat in London a little over a year ago. India, however, is largely indebted to England for money borrowed to build railways and to construct irrigation and other productive works. There are also large annual payments to be made to this country for necessary charges of administration, and the excess of exports enables the country to pay its way in both respects, and to add, besides, a large amount to the savings of the people. The account is finally adjusted through the instrumentality of the Secretary of State, who sells drafts on India during the year for many millions sterling; but the system is one I need not explain in detail.

The net annual imports of gold in recent years have averaged about 20 millions sterling, and as the foreign export trade increases this figure will also increase. To anyone travelling through India the immense wealth of the country is not, perhaps, immediately apparent, but the area is of such vast extent, and the population so large—about 315 millions altogether—that production on a large scale is inevitable. The land in good seasons is very fertile, the soil in many districts is rich and retains the moisture, and the crops, although often rather scanty to the eye, are, on the whole, very prolific. An immense amount of the produce of the soil is consumed by the Indians themselves, and the quantity of food grains exported is probably only a small percentage, but even so, the whole foreign trade—imports and exports—is very large, although per head of the population of 315 millions it only works out at 17*s.* 7*d.* against £25 15*s.* per head in the United Kingdom, whose population is 45 millions—an immense difference, which should, however, be reduced in the years to come as the country grows richer. There are great possibilities in Indian trade, and as the exports increase—raw materials as well as manufactured goods—the imports will also increase. Although in a hot country much clothing is not required, the people in India seem inclined to wear more and better garments as they increase in wealth. Amongst the poorer classes food is the first consideration, and, generally speaking, it is only the surplus wealth that is spent on extra clothing and on other imported articles. As a matter of fact, however, a woman of the working classes can deck herself out almost in the height of fashion for the modest sum of 3*s.* or 3*s.* 6*d.* with a bright-coloured sarry which she wraps round her body and then brings over the head, and with two other small garments in addition, all being made of cotton. A man of the same class can also clothe himself for the same sum with nine yards of bleached cloth wrapped round his head for a puggaree, a dhooty of five yards or so wrapped round the lower part of the body and brought up between the legs, and above this a small cotton jacket. These garments are also made of cotton, and will wash, so, if the wardrobe is small and there is no change of clothing, the wearer has only to wait until the scorching sun has dried the only garment he or she possesses.

The women folk of India love bright clothing, which, in the sunshine, looks very picturesque, and as, no doubt, they like to have a good selection of sarries, the demand for printed and dyed goods is always greatly stimulated after a good harvest, when the people have a little surplus money at their disposal. The cotton goods imported into India come almost entirely from this country, as I shall show later on, but Bombay is now a great manufacturing centre, and there are also many spinning and weaving mills in other parts of India. On August 31st last year there were 84 cotton-mills in Bombay Island and 92 more in the Presidency, a total, with seven in course of erection, of 183 against 271 for the whole of India, so Bombay City and Presidency have the lion's share of the trade. The industry, generally speaking, is a prosperous one, and now that looms are being turned on to different classes of goods there is a great future before the trade. Formerly, the production in Bombay was mainly yarns for

export to China, but now that this trade is falling off owing to the competition of the Japanese mills, Bombay spinners in many cases have added looms to their factories, and are now largely engaged in manufacturing cloth for local consumption. In some directions this interferes with an increase in the importations from Lancashire, but as the people grow richer they will want more and more of the better-class goods produced in this country, and we need, therefore, have no fear for the future of our trade. It is interesting to note in this connection that, whereas in the whole of India there were only 47 cotton mills in 1876, there are now 271, employing 260,000 hands and consuming over 2,100,000 bales of cotton. For the sake of comparison, I may mention that there are over 2,000 cotton-mills in this country employing, however, only 650,000 hands, and I may also add that England, helped by her free trade system, has far and away the largest export trade in the world in cotton fabrics, as she is able to produce on exceptionally favourable terms.

The fiscal system of India is also free trade, and under it the country has undoubtedly prospered. There is, it is true, a tariff not exceeding 5 per cent. on imported merchandise, but this is for revenue purposes only, and, whereas in the case of manufactured cotton cloth there was competition between India and England, a countervailing excise duty was imposed on cloth made in power-looms in India for consumption in the country. After jute manufactures, the cotton industry is the most important, and there is a great future in store for both these trades.

The distribution of India's vast trade in merchandise is a very interesting study, but the bulk of it is with the United Kingdom. The produce exported passes through many hands before it reaches the consumer, but the cost is not added to very materially by this, as Indian trade generally is worked for a very narrow margin of profit. The Indian himself is a born trader, and his powers of bargaining are proverbial. The son follows the father in his trade, and begins to take an interest in the business very early in life. Many businesses are carried on as joint family properties, in which all the members, including the women folk, have a share, and, no doubt, the object of this arrangement is to keep the wealth in the family. The people themselves are very thrifty, and, as I have said, nearly all of them have something laid by—a bit of land in some part of the country to which they will retire in old age, or jewellery for their women folk of gold, silver or precious stones—the latter amongst the wealthier classes being sometimes of great value. They are a shrewd people and know very well the value of what they have to buy and sell. The land is cultivated by many millions of the people, only a very small percentage being employed on manufactured goods, and the exportable crops are very often sold to middlemen or merchants before they are grown, and sometimes even before they are planted. At the time of harvest the produce is collected and sent down in due course to one of the large seaport towns, where it is stowed away in steamers for its destination in Europe or elsewhere. Imports from England and other countries are received by the merchants at the ports, and, after passing through the hands of the wholesale dealers, find their way into small retail shops in the districts or are hawked round the country by an army of travellers. A cloth bazaar in India is a gay sight, and, excepting just at the time of the heaviest rains, there is always an active retail trade going on.

Coming now to figures. The imports of merchandise into India from the United Kingdom alone for the year ending March 31st, 1914, were valued at 78 millions sterling, and from British Possessions and colonies at about 7 millions, a total for the British Empire of over 85 millions sterling out of a total value from all countries of 122 millions, so you will see from this what a very important market India is for Great Britain, her colonies and possessions. From all other countries the total imports a year ago were valued at 37 millions sterling—an important trade, no doubt, and one that will grow, but the British Empire has the lion's share of the import trade, and this she is likely to retain. The supplies from other countries are, in some cases, articles necessary for India which are not produced in quantity in the British Empire, and this trade will continue. Amongst foreign countries Germany has, or had, the largest import trade with India, but many articles which have lately been imported from Germany will now, I think, be made in this country. One very important supply from Germany is aniline dyes, which, I hope, will now be produced in much larger quantities in Great Britain, and if the scheme now being worked out is a success, I trust these English dyes will be put on the Indian market, and that the trade will be pushed in every way possible, for it is very important that India should not be dependent

on Germany for her dyes, and if a change is to be made the trade should come to Great Britain. Great credit is due to the British Government for recognising the importance of this new departure, and for pushing the matter on so successfully against many difficulties, and if the scheme is a success, as I hope it may be, the position of producers of textiles and other goods in the British Empire will be greatly strengthened. To sum up, England last year had 64·1 per cent. of the Indian import trade, foreign countries 30 per cent., and our colonies the remainder. The position as regards exports is, however, very different; the share of this country is only 23·7 per cent., foreign countries 62·2 per cent., and our colonies the remainder, or, say, 13·9 per cent., and it was this fact that influenced Lord Curzon's Government to adhere to India's fiscal system of free trade; for, by a change in the opposite direction there was little to gain and possibly a good deal to lose. I have always felt that in the great controversy of Free Trade or Protection—which is now, perhaps, ended—the important position of India as a part of the British Empire was, to some extent, lost sight of, and that at one time her interests were likely to be sacrificed or subordinated to the colonies. All I wish to say at the present time is, that if the matter ever does come up again for serious discussion, India should always be thoroughly represented, and the immense volume of her foreign trade and its great importance to the people of India should never be lost sight of.

After Great Britain, Germany is, or was, India's most important customer, and then follow Japan, the United States, France, and other countries. The trade with the United Kingdom is mainly in raw jute, tea, and wheat, but importations of other articles are numerous and important, but the list is too long to detail. The importation of raw cotton from India is, as I have said, disappointing, notwithstanding our great requirements, but there are signs of better things if a longer staple can be produced, and I believe this is possible to some extent. I hope the Government of India will continue their laudable efforts at improvement, for it would be a great thing for India if Lancashire was a free buyer.

Cotton is shipped, however, in large quantities to Continental countries, which also take freely of oilseeds, hides and skins, jute (raw and manufactured), and rice; and tea goes in some quantity to Russia through the Black Sea ports and by other routes. The war has cut off a great deal of this trade, and India is suffering to some extent accordingly, but to this I shall refer later on.

The next point of interest in connection with India's external trade is the question of transportation, and the extension of railways in India has always been a matter of the very greatest importance. The increase of the mileage has not kept pace with the times, and in recent years on several occasions the external and internal trades have been seriously hampered by the inability of the railways to handle the traffic expeditiously. The railway policy of the Government of India in the past was constantly assailed by the various railway administrations and by the commercial community as represented by the Chambers of Commerce. The complaint was that, instead of keeping ahead of the traffic and making preparations well in advance for a constantly increasing trade, the policy was one of over-caution, with the result that in recent years traders have often lost heavily by the delay in transportation, and at one time many orders had to be declined from overseas markets, and were, therefore, lost to the country for ever as merchants were unable to calculate on speedy delivery from the districts to the ports. I have told you already that in 1857 there were only about 270 miles of railways in India. Ten years later this had, however, increased to nearly 4,000 miles, and gradually, but very slowly, the figure has advanced to 35,156 miles at the present day, which, considering the extent of the overseas trade and the great possibilities of the future, is a small mileage for such a large country with a population of 315 millions. There are difficulties no doubt, in connection with the question of rapid expansion, and even if the present position was very much better than it is, it will always be a difficult problem after a good monsoon to move with rapidity the heavy crops harvested within a few months, which must, to a great extent, be handled and exported before the next monsoon sets in. To deal expeditiously with a vast trade under such conditions needs perfect organisation, about which complaints have not been serious, a sufficient supply of waggons, ample facilities for rapid transit, and plenty of storage space at the stations up-country and at the ports. It is largely due to failure in these latter respects that so many difficulties have been caused in recent years, but, owing to a free expenditure during the last two years, many of the defects and deficiencies complained of have been remedied, although, perhaps, to some extent, at the cost of a steady

increase in the mileage, which is still far below what it should be. The question of finding money for much more rapid extension and for equipment has been constantly urged as the true remedy for the unsatisfactory state of affairs which existed up to a year or two ago, and whilst I admit that there are difficulties to be overcome in this connection, I do not think the question, if viewed from a really practical point of view and judged by the necessities of the case, is an insuperable one, for I feel sure that if the possibilities of Indian trade were only realised, there would, in normal times be a far greater demand for investment in Indian railways, which are first-class securities. I have already said that matters have improved in the last two years, not, however, as regards extensions which are most important, but in general equipment, and I am only too pleased to be able to acknowledge the great efforts that have lately been made by the Government of India in this respect. For this financial year, notwithstanding the somewhat difficult circumstances in which the Government of India are placed owing to the war, a generous grant of £8,000,000 has been made against a revised budget estimate for the last official year of the large sum of a little over 11½ millions, and I gather from this that the Secretary of State, the Viceroy, and Sir William Meyer, the Finance Member, recognise the great importance of full expenditure on one of the most valuable assets of the Government of India. A policy of a rapid extension of mileage is, however, absolutely necessary for India's expanding trade, and I am one of those who believe that Indian trade is bound to increase much more rapidly in the future than it has done in the past. The people in India who have the control of the trade are full of energy and enterprise, and when this is the case there is no limit in such a vast and prolific country to rapid expansion. There will be, of course, an occasional set-back in the trade and traffic due to an insufficient or irregular rainfall, but this, after all, is a temporary matter which need not be taken too seriously into account in connection with the general railway policy of the Government of India. On this question I hardly need say more, as its great importance is now, I think, fully realised, and it is all for the good of India, her people and her revenues, that railways should be rapidly extended in many new districts, which would soon supply ample traffic of various kinds.

In recent years many feeder railways connecting with the main lines have been built with rupee capital raised in India, and the terms now offered by these companies, with the sanction of the Secretary of State, are much more satisfactory than they were a few years ago. These lines, generally speaking, are built to bring additional traffic to the main trunk lines, and the general results of these "feeders" have, so far, been very satisfactory; to such an extent that when any new line comes on the market the capital is nearly always subscribed with ease, for there is an immense amount of money in India awaiting good investment, and, so far as can be judged from the past, the returns from these lines steadily increase year by year. There is a great opening outside of India for investment, not only in these small "feeders" but in Indian railways generally, and I am glad to be able to say, with some confidence, that expectations of a satisfactory yield will rarely be disappointed. If, however, the main lines were given extended powers in the direction of "feeders," it would undoubtedly help matters, and this is a point which ought again to be considered. The people of India take a keen interest in their railways, and although some of their proposals in connection with the railway policy of the Government of India are somewhat revolutionary —as is instanced by a resolution brought forward in the Imperial Council at Delhi only a few weeks ago by an old Indian friend of mine—it is very satisfactory to feel that the importance of a successful railway policy is recognised as beneficial to the country in many ways, and that the all-important question of more rapid extension is likely to be kept well to the front in future years.

The prosperity of India, the welfare of its people, and the success of those who trade, is so wrapped up in the general question of railway administration and development, that I feel I may be excused a special paragraph on this most important subject, which the commercial community keep very much to the front—as they are bound to do if the foreign trade of the country is to be carried on successfully. Closely allied, however, with this important question is the extension of dock and harbour development, and in this respect, I am glad to say, the country has not lagged behind. There have been difficulties in the past in quite recent years, but the development of the ports is a matter which is always before the merchants of India, and great efforts have lately been made to bring dock facilities up to, and beyond, the requirements of the foreign trade, and,

generally speaking, with success. The growth of irrigation works in India is another matter of very great importance, and much good work has been done in this direction in recent years. The subject is one on which a great deal might be said, as a system of artificial application of water to the land for purposes of agriculture has existed in India—as in most other Eastern countries—from time immemorial; but it will suffice if I say that vast tracts, many millions of acres, largely in Sind and the South-Western Punjab, have been brought under cultivation by canals and tanks, and that valuable crops are being reaped therefrom. The advantage of irrigation will be recognised when I say that there are large tracts in the north and west which are almost rainless, and others, such as the Deccan, where cultivation is extremely precarious, owing to the great irregularity of the rainfall and the long intervals during which crops may be exposed to the fierce heat of the sun and to dry and scorching winds. The extension of irrigation in various parts of India is, therefore, a matter of great importance, not only to the people of India when famine threatens, but to the foreign trade, as large crops can now be raised on irrigated areas which otherwise would not be grown at all. Karachi, the great port of Sind, has benefited immensely in recent years by irrigation works in the northern part of the province and in the Punjab, and the great increase in the exports of wheat is mainly due to this cause. There is still, however, much to be done in this direction in other parts of India, and I was glad to see, only about a month ago, that another large scheme has been sanctioned in the Belgaum district of the Bombay Deccan.

Before I close this part of my paper, some figures of the average wages paid in various selected industries will be of interest. In cotton spinning and weaving mills the average paid is 23*s.* per month, not per week; in jute, 5*s.* 2*d.* per week, or about 22*s.* 3*d.* per month; and in coal-mining a little over 6*d.* per day, which seems a very small amount when compared with the wages earned by miners in this country. Agricultural wages generally are small, but they vary with the seasons, and when crops are bountiful they are high, relatively speaking—for labour in India is none too plentiful, as is generally supposed. The tendency of wages in recent years has been decidedly upwards, owing to a variety of causes, one being the generally increased cost of living due to the rise in prices, which, in some small measure has, perhaps, been brought about by the fact that, as the people are richer they are now supposed to be eating three meals a day instead of two. I hope they are, for if this is a sign of an increase of wealth they will be able better to stand a time of scarcity when it comes, and that it will come is certain, for the Indian monsoons vary considerably, and although for some years past they have been very good and crops have been bountiful, the time will come when they will be scanty and when there will be many areas of scarcity.

I will now refer for a few moments to the effects of this great and terrible war on the foreign trade of India, which, so far at any rate as exports are concerned, is carried on, as I have already mentioned, very largely with the Continent. When war was declared, the effect was immediate and far-reaching, not only on the foreign trade of India, but on the trade of the whole world, and for some little time business everywhere was very much disorganised. The uncertainty was so great that, for a time, all ordinary business was more or less at a standstill, and when foreign trade was resumed merchants in all countries had to adjust their calculations to absolutely changed conditions, to very much higher rates of freight, and, in nearly all cases, to a greatly depreciated exchange. The cost of production was also immediately affected and is still rising, and in many instances consuming markets were unable to adjust themselves rapidly to the altered conditions. The trade of India suffered with the rest, excepting in this one and very important particular, that, thanks to the prompt appreciation of the fact and to the support afforded by the Government of India, the gold exchange hardly varied, and India in her financial transactions has kept faith with the whole world. It is true, of course, that the ordinary financial transactions of the Government of India were considerably upset, and that, instead of sending money to this country to meet current liabilities, reverse remittances had to be made to the extent of nearly 9 millions sterling to maintain exchange; but the financial position was so strong and so sound that these reverse transactions were effected without any special difficulty, and when the Finance Member presented his Budget Statement to the Imperial Legislative Council early in March, he was able to announce that, notwithstanding a deficit for the official year just then ending, and the prospect of a further deficit for the present year, and notwithstanding also the falling off in trade and the expenses

to which the Government of India were being put in connection with the war, there was no necessity to impose additional taxation, and this statement, which was unexpected, was, naturally, well received. The inherent strength of India's financial position in a time of very great stress is a most satisfactory feature of Indian administration, and when the position is more completely realised and understood by investors in this and other countries, it should lead to a much larger investment of sterling capital in the country in railways and industrial enterprises of all kinds. India, at the present time, is making great strides in various ways, and many of its new enterprises, notably the Tata Iron and Steel Works, which is now making good progress, and the great hydro-electric scheme lately opened by Lord Willingdon to supply electrical power to the mills in Bombay —which will do away with the smoke nuisance and make Bombay a more beautiful city than ever—are due, I am glad to say, to the foresight and energy of enterprising men in Bombay, a city with which I have been associated, or, more correctly, in which I have lived for nearly thirty years. I feel, however, that, from the industrial point of view, India is only at the beginning of its expansion, and the country is fortunate in having, as an executive member of the Government of India, a representative for Commerce and Industry, for the advice and assistance of Government are often of great value in the development of new schemes. The Department of Commerce and Industry was founded by Lord Curzon when he was Viceroy of India, and it has been my privilege to have been intimately acquainted with the gentlemen who have held this important office. Might I in this connection suggest for favourable consideration that a Commercial Member of recent Indian experience might also be of value on the Secretary of State's Council in London? India, as I have said, will always be mainly an agricultural country, but there will always be an immense field for the profitable investment of capital in other ways, which, if wisely handled, will yield a satisfactory return. I do not mean that all Indian enterprises will necessarily be successful, but with good, honest management, a sound industrial undertaking is almost certain to yield a good return, and in railway extensions and development there are also great possibilities — some of the "feeder" lines to which I have already referred being at the present time, after only a few years' working, a very satisfactory investment for those who have been interested in them from the start.

Very fortunately for India the war commenced in what is known as the "off season," or during the height of the south-west monsoon, when the export trade is always more or less at a standstill, and when, as a rule, there is but little doing in imports. Had it begun a few months earlier the very greatest inconvenience would have been caused, for in the first six months of the year the foreign trade is at its height, the railways are working at full pressure bringing produce down to the coast, docks are full to overflowing, and the whole country is straining to market the valuable crops grown during the cold-weather months. When the war began, therefore, the Indian shipping season was, most fortunately, over; but even so, there were many steamers afloat for Europe carrying produce from Calcutta, Bombay, and other Indian ports, and as some of these boats were vessels belonging to German and Austrian lines they were captured by our fleet either before they reached Aden, or as they came out of the Canal, or whilst they were in the Mediterranean or the Channel. The steamers of the German Hansa Line have carried for years large quantities of Indian produce to German and Belgian ports, and numerous vessels of the Austrian Lloyd Company were engaged in the trade between India, Italy, Austria, and other places in the Mediterranean, Egypt, and elsewhere. All boats *en route* belonging to these two lines had either to take shelter in a neutral port or were captured, the latter with their cargoes, which belonged, to a great extent, to British and neutral merchants by whom they had been shipped in the ordinary course of business before the war broke out. The capture of these cargoes has led in many cases to complications, and at the moment it looks as if shippers may be involved in heavy losses through no fault of their own, but I am glad to note that, although the Prize Court decisions in many of these cases may be adverse, and, consequently, a great hardship to many British merchants, our Government have appointed a special committee, to which, I understand, appeals can be made for compensation; and, under the circumstances, I can only hope that a liberal and generous view of the position will be taken by the members of this committee, so that, in addition to the ordinary — or, should I not say, the extraordinary — trade losses of the present time, British and neutral merchants may not be called upon to bear other losses which they

were unable to protect themselves from in any way.

The effects of the war on the foreign trade of India were, as I have said, immediate; and in August and September the imports into, and the exports of merchandise from, India fell off very materially when compared with the same two months in the previous year, which, however, as regards imports, were, perhaps, above the normal. The export trade in these two months suffered most. The falling off was just over 50 per cent. as compared with the previous year, the chief reasons being the complete stoppage of business with Germany and Austria —both valuable customers—and the unwillingness of merchants to ship to neutral countries on the Continent, owing, in some measure, to difficulties of finance. Steamer freights also rose rapidly, and as tonnage was scarce owing to the heavy requirements of Government for trooping and other purposes, there were not the usual opportunities of dispatch. Everybody, in fact, waited to see what was going to happen, and, as a consequence, a great number of running contracts were either delayed or cancelled. At some of the large ports a rather serious view was taken of the position by a section of the community - chiefly the Marwaree or trading class, whose homes are in the districts—and they departed carrying with them as much gold as they could lay their hands on. Because of this, and owing to certain wise restrictions of Government, gold in circulation became scarce and went to a premium. There was also a considerable run on the Savings Banks, and Government Notes were presented freely for encashment both demands being, however, promptly met. Then the "Emden" appeared, and whilst she was in and near the Bay of Bengal, shipping from Calcutta and the east coast was more or less at a standstill. The bombardment of Madras aggravated the position, and as wild rumours spread rapidly over India, an immediate revival of trade seemed at that time to be quite out of the question. The sinking of the "Emden," however, changed the position entirely, and many traders who were, no doubt, tired of sitting up country doing nothing, seem then to have concluded that, at any rate, so far as they were concerned, the war was probably over, and by degrees they began again to take an interest in business. In nearly all the accustomed channels trade was very much checked, and in this connection I cannot do better than quote from Sir William Meyer's extremely interesting Budget speech, which many of you will, no doubt, have read. In referring to difficulties in Calcutta in connection with the jute trade, Sir William pointed out as a sign of the times that, whereas between August and October 1913 the issue of rupees from the Calcutta Currency Office in connection with the financing of the jute crop amounted to some 13 crores of rupees, the net issue in the corresponding period of 1914 was only about 56 lakhs, which is just over half a crore. As regards tea Sir William Meyer pointed out that, after the United Kingdom, India's largest customer for this commodity is Russia, and the disturbance to finance which accompanied the war rendered it impossible, at first, for Russian buyers to make their usual purchases. The difficulty was, however, subsequently surmounted, in part by financial arrangements made between His Majesty's Government and that of Russia, which supplied funds in London towards exchange facilities for Russo-British trade. In this and other ways trade gradually revived, and, as so often happens in exceptional circumstances, new markets also began to appear, to such an extent that before very long there was an active demand for jute, tea, coal, and many other articles. Russian orders for shipment to Vladivostock were also in the market, and, as I have said, from many other quarters a new demand seemed to spring up. The effects of this on the export trade were not apparent until November, but even then and in December the falling off was heavy in comparison with the previous year. It is, however, very satisfactory to note that, after a severe check, trade in many directions is reviving rapidly, and I will illustrate the present position in the East by referring to the remarks of the chairman of one of the Indian Exchange Banks at the annual meeting a few weeks ago, when he said that:—

"The rice crop in Burma is good, the wheat crop in India is excellent, the tea industry in India and Ceylon is most prosperous, the jute mills in Bengal are likely to show good results in the present year, and the rubber industry is in quite a healthy condition."

Rubber is not really an Indian crop, but tea and jute are produced very largely, and as the wheat acreage this year is very large, and the crop, owing to favourable weather, an exceptionally good one (the latest estimate I have seen is a production of over 10¼ million tons on an area of just over 32 million acres, against an estimated out-turn last year of 8½ million tons), there is, or should be, a large amount—perhaps 2 million tons available for export. Only a

small proportion of the Indian wheat crop is, however, exported in normal times; but whatever the amount, it has an important influence on the world's markets, and, consequently, on prices. The export of wheat for the present, owing to the war, is being controlled by the Government of India, and conditions, to some extent, are, therefore, artificial; but it is a comfort to know that, after a year of rather poor supply, India has now gathered a splendid harvest, and that, after fully supplying her own needs, there will be a large amount available for us and our Allies. Calcutta has benefited most by the revival of trade—coal, jute, and tea being very important items in Bengal. Coal has been in great demand owing to the scarcity of tonnage which is due to so many vessels having been taken up for war purposes, and freights, owing to this and increased working expenses, have consequently risen. Jute has been bought freely for a great variety of purposes and tea has been in active demand for our Navy, for the troops in the field, and for general consumption. The improvement in Calcutta trade has added very largely to the receipts of the railways serving that port, and in comparison with the previous year's figures the result is now generally satisfactory. Not so, however, in Bombay and the western ports, for the receipts on the large trunk lines serving these districts fell off very heavily at the commencement of the war, and are still very far below the corresponding figures of last year. The foreign trade of Bombay has not had the same stimulus as Calcutta, owing to the different articles dealt in, cotton and oilseeds being the largest commodities handled in Bombay, and there cannot be much increase in the exports of cotton and oilseeds to Europe until the war is over. Japan, it is true, has been a good buyer, but the trade lost by the shutting off of Germany and Austria cannot well be replaced. As regards the import trade, there was, of course, a serious check all round; but after a few months business began to revive again, and India for some time past has been a valuable market to our manufacturers. Looking back a few months, it is wonderful how the Indian trade in merchandise has revived, and how rapidly India has adjusted itself to new conditions, and, in many cases, to much higher prices. Although freights in many directions have doubled, and, in some cases, trebled, trade still goes on, and is not likely to be checked if India has another good monsoon. The abnormal conditions have, no doubt, been profitable in some directions, but trade has been worked under many difficulties and with many additional but unavoidable risks. There is no reason, at the present time, to take a pessimistic view of India's foreign trade. Some valuable markets have been temporarily lost, but others have been found, and if the export trade can be carried on, the trade in imports will also continue. A demand since the war began has sprung up in this country for many articles which, in the past, have been bought in Germany; and efforts, I am glad to say, are being made to capture this trade, which is of considerable value. The question has been taken up with vigour by His Majesty's Government, and a very interesting collection of articles is now on exhibit at the Commercial Intelligence Branch of the Board of Trade at 32, Cheapside. I have been there and would recommend anyone interested in trade matters to visit these offices and to see for himself the many odd and end articles for this, generally speaking, is a fair description of them - which have been made in Germany and in Austria for sale in India, and the trade I know from experience has grown very rapidly in recent years. I am told that many of our merchants and manufacturers have inspected these exhibits, and that much good, from a trade point of view, is likely to result from this praiseworthy effort of our Government. I am not one of those who run down and belittle the British manufacturer, as he is a man of great energy and resource, but he does not always pry into little things in the same way as the Germans have done, nor does he care very often to make the small and cheap articles which, in many directions, Germany has made a speciality; but I feel confident that, as a result of the Board of Trade's efforts in this direction, the best of this German trade will be secured by our manufacturers, and this will be a valuable addition to our trade with India. I do not want to go into the past, but there can be no doubt that the passing of the Merchandise Marks Act in India a good many years ago, which compelled all foreign goods to have the country of origin stamped or marked upon them, has been the finest advertisement possible for German goods in the Indian markets, and a great deal of good business has been lost on this account to British merchants. As regards the exhibits to which I am referring, expensive and elaborate machinery will, in some cases, be necessary to produce them, but if there are fair prospects of the trade remaining in this country our manufacturers are not likely to be backward; and many of them, I am told, are astonished at

the variety and ingenuity of the articles produced in the manufacturing districts of Germany. In India, as incomes are small, there is an enormous demand for cheap supplies, and as the goods from the Continent are, in nearly all cases, very nicely got up, the business has rapidly increased, and this is a point our manufacturers must bear in mind if they are to capture the miscellaneous trade which for many years past has been done by Germany and other Continental countries. A perusal of the Board of Trade's list of articles for which they have had inquiries is extremely interesting, and I can only hope that this great help to commerce will become a permanent part of the work of our Board of Trade, and that it will lead to the revival of many industries in this country, and to the creation of many new branches of business. I am glad to have this opportunity of testifying to the good work that is being done to develop our trade, which, I am sure, in time will prove to be very valuable.

And now, before I close, I would refer for a few moments to another subject which does not directly affect our trade, but is of the greatest importance to the future of our great Indian Empire, and would say a few words in appreciation of the splendid efforts India has made and is still making on behalf of the Empire in the war we are now waging on the Continent and in many other parts of the world. I remember what India did at the time of the Boer War. I was in Bombay when her brave troops left, and to one who has lived in India so long, and has liked and appreciated the people, it is splendid to know that they have come forward as they have done, princes, chiefs and people alike, spontaneously and enthusiastically, and have vied with each other in offering men, money and equipment for the successful prosecution of our cause. The clash of arms appeals to the Rajput chieftains and to the people of Northern India, and it is, I know, a privilege and an honour to them to be allowed to serve their Emperor on the field of battle. The magnificent response made by our Indian Empire has evoked the greatest enthusiasm in this country, and has caused, I believe, and I am glad to think, the greatest surprise in the countries with whom we are at war. It is a splendid testimony to our successful rule which, now that the world has risen in arms to decide whether in future government is to exist for the benefit of the people, or the people for the benefit and ambitions of government, is appreciated as it has never been appreciated before. There could be no doubt whatever as to the answer India would give, and she has given it already in the splendid response she has made to our call for the maintenance of free and enlightened government. By our wise and liberal treatment of the Indian people we have proved to them the sincerity and justice of our rule. We have given them the fullest possible scope compatible with good government, we have enlarged the Legislative Councils—a wise and prudent measure initiated and carried out by the late Lord Minto and by Lord Morley. We have admitted their ablest men also to the Executive Councils as well as to the Council of the Secretary of State, and there will always, I am sure, be clever, sound and patriotic men, willing and anxious to fill these posts, for in this way they can serve their country and their fellow men. And one of the best of these has lately passed away in the person of the Honourable Mr Gokhale—an enthusiastic and patriotic Indian, who died, most unfortunately, only a few weeks ago. He was a man for whom I had always a great liking and a great respect, and his influence was always for good. All honour, then, to the brave men who are fighting for us in the trenches in France and in Flanders, in the Persian Gulf, in East Africa and elsewhere, and all honour to those who have laid down their lives for the Empire. Their memories will not be forgotten, and their heroic deaths will help to draw us closer to our Indian Empire, and our Indian Empire closer to us.

DISCUSSION.

THE CHAIRMAN (the Marquess of Crewe), in opening the discussion, said he felt certain that the concluding passages of the paper would have struck a note of sympathy in the mind of every member of the audience. It was impossible to reiterate too often in this country our sense of the debt which we owed to the people of India, without distinction of race, or class, or of religion, for the part which they were taking in the present stupendous struggle almost all over the world. He had had more than one opportunity, and he should have more, of expressing, as Secretary of State for India, his own sense of the debt which was owed in the first place to the Indian troops, who, in the different scenes of combat, had equalled and, if it were possible, had excelled the feats of the wars of the past, then to the Indian princes, who had carried on the traditions both of chivalry and of munificence which they had inherited from long lines of ancestors; and lastly, but not least, to the whole people of India, men and women alike, who had come forward according to their different opportunities and means to testify their support to

the Government of the King-Emperor, and had done so because they knew that our cause was that of righteousness and justice. He did not propose to make any attempt to follow the author of the paper through the comprehensive and most interesting review which he had given of the commercial and industrial activities of India. All he (the Chairman) would attempt to do would be to call attention to one or two points relevant to the later part of the paper, namely, the particular condition of affairs which had been brought about in connection with Indian trade and industry by the war. In the first place, he thought it would be altogether idle to disguise the fact that we could not expect, and indeed ought not to expect, the ordinary small trader or cultivator in India—whose affairs at ordinary times depended in their vicissitudes only upon the caprice of the season or of the market—to regard with complete indifference or acquiescence every result which might be brought home to them personally through the present gigantic convulsion. It was, therefore, the serious duty of Government to attempt, as far as possible, to temper to those people such results, and that was the origin and the cause of a transaction which Sir Charles had mentioned, namely, the veto which had been placed upon the export of wheat on private account until well into the spring of next year, and the substitution of sale on Government account. That also had been the object and purpose of the measures to which Sir Charles alluded which were taken by Government for the purpose of supporting exchange; and he was grateful to Sir Charles for the approval with which he had spoken of those measures. There were only two matters to which he further wished to refer- two desires which he entertained in connection with the present crisis. Both of them were connected with subjects to which Sir Charles had alluded. In the first place, it was his earnest hope, and he was certain it was also the hope of the Government of India, that it might be possible throughout the present struggle—of which the end could not be seen—to continue the policy, which had so far been pursued, of not imposing any fresh taxation upon the people of India. In this country it had been found necessary—and, he believed, altogether wise to follow a diametrically opposite road. But the people of India were giving exceedingly large amounts of money towards the prosecution of the war, and what was infinitely more precious than money—they were giving many lives. That generosity was true of both countries, but what was special to India, and which was at the bottom of the desire not to impose any further taxation on India, was that, as was well known, it was exceedingly difficult, in the circumstances of India, to devise any scheme of raising fresh revenue by taxation which did not hit the very poor classes in the country. If it were merely a question of taxing the superfluities of the wealthy, the problem undoubtedly would assume a somewhat different aspect. His other desire was based on the hope that, to as small an extent as possible it might be found necessary to curtail expenditure on productive works in India—such works as railways, canals, and the like. On that subject Sir Charles had dwelt at length. Sir Charles had stated what the great railway system of India had done for the country and how warmly he desired that it might be extended. The same considerations applied to irrigation, to harbour works, and to many other public enterprises; and, so far as was possible, everything had been done not to lower the scale of expenditure on those public objects to a greater extent than the circumstances made absolutely necessary. But it was necessary in that connection to look at the conditions here. Probably all were aware that it had been found necessary in London to limit public issues of capital of all kinds, whether they were connected with municipal enterprise or with private enterprise, even although they might apply in a great number of cases to objects of the first importance, which everybody wished to see promoted and carried through. That embargo on the issue of capital applied not only to this country but also to the self-governing dominions and the colonies, and it applied also to India. India issues on the London market were most rigidly, and of necessity, limited Bearing in mind what Sir Charles had stated as to the hopeful advance which had taken place of recent years in India in the investment of Indian capital in that country, he (the Chairman) desired to point out that anybody in India possessed of capital to invest and who would take a share, be it large or small, in a rupee loan issued by Government, was not merely doing something which assisted in the development of the country but was thereby positively assisting in the prosecution and carrying on of the war. The limitations which had to be imposed on the issue of capital either for India or for other parts of the Empire in our market here were founded on the fact that the maintenance of British credit stood only second in its effect on the prosecution of the war if it be second to anything—to the continual supply of men to go to the front, and the supply of munitions with which to arm them. He said, therefore, that the investor who in India would, according to his means, come to the front in that way was doing a public service. All recognised of course, the almost unending liberality which had subscribed in India to the various war funds which had been raised. Nothing too grateful could be said of that, but there should also be kept a word of distinct praise for the Indian patriotic investor.

Mr. C. C. McLeod said on an occasion like the present, one was expected to criticise the paper that had been read, but he was bound to say that in all he had heard in the very interesting address which Sir Charles Armstrong had just given he could not bring himself to criticise anything. On the contrary, he was very much in accord with all the author had said in regard to the subject. Sir Charles had covered a great deal of ground, starting

with the early history of India and its trade, and following it up by giving the result of monsoon effects, together with a very great deal of instructive knowledge in regard to the growing and cultivation of cotton, wheat and other articles—not to speak of statistics of a very comprehensive nature. He had also mentioned the jute trade, and spoke of the eastern side of India, which more closely affected Calcutta than Bombay. The jute trade certainly was a most important one, and a monopoly of Bengal. It was, however, at the disposal of every country in the world, without any prohibition or protective disabilities. As a contrast to the facilities given to the Germans for getting jute (for which there is no substitute in the world) he (the speaker) would point out the methods of the Germans in the only colony in which they were producing sisal fibre, viz., German East Africa. There every machine was of German manufacture (Krupp's), shipped in German bottoms, to German ports only, financed through German banks, and sold through German brokers, and all disputes arising were to be settled by Germans only! Fortunately the tentacles of that octopus had now been clipped, and he trusted it would not be long before the body of the beast was as extinct as the Dodo. The growth of the jute industry had been a remarkable one, and the uses to which the fibre were now put were varied and extensive, and the manufacture of it into cloth and yarns in Calcutta was a very large trade in itself. Instead of the two or three mills in Calcutta which existed when he went out in 1878, there were now about fifty mills, exporting about a million tons of goods manufactured from jute to every corner of the world. Those mills employed a very large number of natives, who got well paid and were well looked after. The tea industry was also one that had expanded very largely in late years, and had reached a very considerable figure of over 250,000,000 lbs. of tea from Northern India. Another important industry which had succumbed to the competition of German chemistry was indigo, and he hoped and trusted that it would now have a chance of being resuscitated on a permanent basis, and that the German Badische would never be heard of again. Sir Charles had alluded at some length to the importance of the railway system in India, and he (the speaker) hoped with him that its great importance was now fully realised. It was a subject he himself had had the privilege of bringing before the noble Chairman on more than one occasion, and all appreciated his lordship's practical sympathy in doing all he could to further its extension in India. He might, in connection with that subject, refer to what was known as the Mackay Committee in 1908. Several witnesses before that Committee gave their opinion that the 30,000 miles then open would be in the near future increased to 100,000 miles, and the Committee, from the evidence before them, stated: "We believe that even their estimate of mileage is short of what will ultimately be found necessary in India, and we are convinced that there will be fruitful fields for large reproductive expenditure on railways in the country for years to come." He might also add that Sir Guy Fleetwood Wilson, in his Budget speech of 1913, remarked, "We have in our railways a splendid asset," and acknowledged "the immense significance of the railways as an instrument of general progress; their necessity for development of trade; their growing, and, indeed, their momentous importance to the finance of India." He further added: "Our responsibility is all the greater now that they have attained a position of supreme importance in our financial system." The introduction of feeder lines to the main railways was of immense advantage, and promised to become a very extensive proposition. The Secretary of State, in sanctioning a positive 3½ per cent. Government guarantee to approved feeder lines, had made a marked advance, not only in that many more lines were now in course of construction, but what was perhaps of the greatest importance, the capital for these lines was being subscribed entirely in India. The natives had come forward as free subscribers, and it might interest the meeting to know that very lately two railway projects were put before the Calcutta public, when £700,000 was subscribed in a few days, many of the subscribers being rajas and landholders, in sums of £20,000 to £50,000 each. The effect on the old system of hoarding was obvious. Akin to the railway system of India came the question of port facilities. There was no advantage in extending and equipping railways if the ports to which they centred were not capable of dealing with the goods they brought forward for export. Great advance had taken place in that direction. Sir Charles would remember when Karachi was only a sandbank and Bombay a very small port indeed, while in Calcutta, when he (the speaker) went out there in 1878, there were only a few jetties alongside the River Hooghli. To-day, Karachi was a very large port, Bombay had converted her harbour into extensive docks, and Calcutta had not only extended her jetties, but had made extensive docks which were now to be doubled. He doubted very much if even all that could cope with the increased traffic, and he would like to read a short paragraph of what he had said at the annual meeting of the Bengal Chamber of Commerce in 1913 "But it appears to me that a very bold programme will be necessary for Calcutta if we are to pay any attention to what the increase of the past few years has taught us. The imports between 1910-12 for all India have risen from 60½ millions to 85 millions, while in the same period exports have advanced from 80½ millions to within a fraction of 100 millions; these are the figures for all India. Now, we confine ourselves to Calcutta and take the advance during the last three or four years at a safe percentage, it has been put as high as 12, official figures bring it out to something like 9 per cent., which corresponds with the increase on inland trade into Calcutta; but taking into account

the higher value of most of the commodities, it will be sufficient if I take it at 6 per cent. and multiply it by sixteen years, you will have at the end of that time double the export business you have now, and no doubt a very considerable increase in imports as well, and surely a very bold programme in the face of such figures would be whittled down to one of ordinary common prudence." It must never be forgotten that India is not only a country, but really a continent, and that, with all those increased facilities, trade was bound to increase by leaps and bounds. He was one of those who, like Sir Charles, was full of optimism where India was concerned, and shared with him the feeling that the industries were only in their infancy. As most knew, the agricultural industry was a very extensive one, but, withal, a very crude one. Taking the instance of the ordinary cultivation where the ground was tilled with the aid of a piece of wood pulled by a pair of emaciated bullocks, and the seed sown perhaps out of stock which had never been changed since it was handed down from the Ark, it did not require a great stretch of imagination to see that, if the form of cultivation were improved and fresh seed imported, the result would be a hundredfold yield. Like all places in India, the trade in Calcutta had been thoroughly upset and paralysed for a time by the war. Exports had ceased owing to the difficulty in negotiating drafts. But, thanks to the prompt action of the Government and the stability of the currency system, these difficulties were soon overcome, and trade was in full swing early in September. Contrary to expectations, the markets for jute and tea remained steady, and, in the case of the latter commodity, advanced latterly to prices not seen for the past twenty-five years. The only fear in the future was the difficulty in securing freight to bring home the large crops that are expected this season, but possibly it would not be so bad as expected. Sir Charles had referred to the help that we had received from our Indian fellow-subjects in the wonderful effort they had made in showing their loyalty to the British Crown. It was most gratifying. He was glad to think that, as a member of the Committee of the Indian Soldiers' Fund under the able chairmanship of Sir John Hewitt, they had been able to add by voluntary subscription to the comfort of the troops who had come over to fight for us, and he hoped to go over to France very shortly to consult with Sir James Willcocks—their gallant commander—in regard to what comforts they might require during the coming hot weather. He would conclude by reading an extract from a recent letter from Sir James, which he thought would be considered gratifying. Sir James said: "It is good of you looking after the welfare of my men. They are the most loyal fellows that ever lived, possessed of that extraordinary nature which will endure the greatest trials and fight bravely for the Government they serve. This India experiment in Europe will live in history as the most remarkable example of the reality of British rule."

Sir Alexander McRobert said he desired to point out that the Bombay man and the Calcutta man always took rather a narrow view of India. They knew all about exports and imports, but forgot that there were many other things to consider when dealing with the trade of India, especially with regard to the war. The last speaker had mentioned indigo. Indigo used to be an important article of production in India, but the introduction of the synthetic method of manufacture reduced the price to such an extent that the planters thought they could not live, and dropped the cultivation. Accustomed as they had been to prices ranging from 4*s.* to 8*s.* per lb. year after year, they had never felt the necessity of looking for higher yielding varieties of the indigo plant, nor of taking steps to improve the methods of cultivation and manufacture. The margin of profit was so great that fortunes were made easily and quickly, and the Macleods, the Mackinnons, and the Mackenzies—they nearly all came from the west country—were able to retire to their native land, after a few years of existence as a sort of feudal barons, and buy islands in the Hebrides. Then when the price fell to 2*s.* per lb., under the stress of the competition of synthetic indigo, they gave up the fight without a real struggle—which was simply playing into the hands of the Germans. He was one of those who had always maintained it had been a mistake to give up the cultivation of indigo. He was credibly informed that fine Behar indigo could be produced at about 1*s.* 8*d.* per lb., by taking advantage of the results of recent research regarding the best methods of cultivation and manufacture, and working on strictly economical lines—in short, by taking a leaf out of the book of the Java planter. That was cheaper than synthetic indigo at 8*d.* per lb. for 20 per cent. paste; and now the German product was out of the market, fine Behar indigo was selling at 14*s.* per lb. It was, therefore, reasonable to expect that one effect of the war would be the resuscitation of the indigo industry in India. The area under indigo was certain to be largely increased if the seed difficulty could be overcome. With regard to the question of wheat, it was anticipated that India would be able to export during the present season, under Government auspices, something like 2,000,000 tons of wheat, on which £5,000,000 profit was expected to be made. He was glad to learn that that profit was not to be regarded as revenue, but was to be earmarked for the benefit of the ryot. The area under wheat in India might be taken as 32,000,000 acres, but the average outturn per acre was something less than 11 bushels. In this country the yield had been gradually worked up to 32 or 33 bushels. This high outturn was got by more intensive cultivation, by the free use of fertilisers, and by employing for seed only the best varieties of wheat, evolved by laborious cross-fertilisation and toilsome experiment. The difference was very great, and he would not be so extravagant as

to ask India to even double the outturn all at once. He would ask for only the modest increase of one bushel per acre, which should certainly be possible of attainment. At the experimental farm attached to the Agricultural College, Cawnpore, Mr. Martin Leake, by merely an extra and deeper ploughing at the right season, had got outturns of over 20 bushels per acre. The Howards, at Pusa, had produced a new wheat of high yielding qualities, and it had been sown over a considerable area in the Aligarh district. Efforts were being made to introduce these improvements over a gradually increasing area, and a marked effect might be looked for before long. A very little arithmetic would show that if the output was increased by only one bushel per acre, it meant, at the present price of wheat, £12,000,000. He was hoping that one result of the distribution of the £5,000,000 would be that the cultivator would be induced to cultivate his land better, to plough a little deeper, to use better seed, and to employ fertilisers. In the latter connection he would remind them that there was a very large export of bones from India, which, in his opinion, was little short of a crime. Every ounce of bone that could be collected should be applied to the soil—finely ground or dissolved—for the bone contained practically all the phosphoric acid removed from the land by the crops, and if it was not returned the soil became gradually impoverished. He would prohibit absolutely the export of bones from India

Earl Brassey, G.C.B., said it afforded him great pleasure to move a cordial and well-merited vote of thanks to the author for his most valuable paper. When he thought of his near relatives, Lord and Lady Willingdon, doing their best in the responsible position which they filled in Bombay, it was a great pleasure to pay due honour to one who had been chairman of the Chamber of Commerce of the magnificent port of Bombay.

Mr. T. J. Bennett, C.I.E., in seconding the vote of thanks, said in giving the paper Sir Charles had co-operated very willingly and very admirably with one of the chief purposes of the Indian Section of the Society. He might almost define that purpose as that of a beneficent trap for catching Anglo-Indians. It had been a declared purpose of the Indian Section for some years past to "rope in" Anglo-Indians of distinction as soon as they returned home. One possible reason for that was that it had been said, on authority which few would dispute, that when the Anglo-Indian had left India and settled at home he very soon forgot all about the country, that his knowledge of it evaporated, and that he ceased to be in a position to judge of what was going on in India. No such charge could be brought against Sir Charles Armstrong, who was an up-to-date authority upon all Indian matters.

The vote of thanks was put and carried unanimously.

Sir Steyning W. Edgerley, K.C.V.O., C.I.E., said the present meeting brought to a conclusion the work of the session of 1914-15. For the past twenty years it had been the custom for Secretaries of State to show their interest and their sympathy in what was done in the Indian Section of the Society by taking, on occasions, the chair at the meetings, but no Secretary of State had come there in circumstances of a year so responsible and so strenuous, and when the call on his time was so great. However, he (the speaker) had not thought it right to conclude the session without giving Lord Crewe an opportunity to be present, although he felt very great diffidence in making the suggeston. He had made it in a very tentative form so that it should be very easy for Lord Crewe to refuse, but the suggestion had been met with a readiness which was extremely cheering, and which seemed to show that there was some truth in the old adage that it was the busiest of men who had the most leisure. He desired on behalf of the Committee to state to Lord Crewe how very highly they appreciated his kindness in attending.

The Chairman, in reply, said in any case it would have been a distinct pleasure to him, as well as a duty, to follow the example of his predecessors at the India Office in presiding at one of the meetings of the Society. He had been more than repaid by having had the pleasure of listening to Sir Charles's illuminating address on a subject of perpetual moment and of thought to himself, and upon which he was very glad to have the benefit of Sir Charles's opinion

DOLL-MAKING IN STAFFORDSHIRE.

An article appeared in the *Times* in August last giving a summary of specific trades which were at that time solely carried on by the Germans. This included some remarks about the making of dolls and toys, and English people were reminded that this trade had at one time flourished exceedingly in England. This at once produced a desire to investigate the matter and, if possible, solve its difficulties. Inquiries showed that the art of doll-making in England had almost entirely been given up for some forty to fifty years, first one and then another manufacturer being driven out of the trade by the cheap German doll-maker, till at last every doll sold in England was imported entirely from Germany—heads, eyes, bodies, and in many cases clothing. Exactly the same state of affairs existed in Russia, Belgium, and France. The last country, however, still retained some of its factories, and is now in a position to supply a moderate number of French dolls.

The art in England had so entirely died out that all inquiries and advertisements failed to discover anyone who had even been trained in this industry, and therefore the only way was to take courage and rush in where possibly the angels would have feared to tread.

Ignorance on the one hand, and a desire to succeed on the other, led us on through months of many and apparently insuperable difficulties, and finally ended in the formation of the British Toy Company, with a small factory at 29, High Street, Stoke-on-Trent.

It would be as well to mention a few of the troubles which beset us. To begin with, glass eyes were not to be obtained in England, having all been made in Austria. This, however, has been partly overcome by the energy of a glass-eye (human) manufacturer, who came forward and produced what was wanted. Then came the question of the heads. This seemed at one time an almost impossible difficulty; however, some manufacturers in the Potteries made many and costly experiments, and now at last one or two have produced a head, which it is safe to say is quite as artistic, and quite as well finished as the German head. The material for stuffing the body presented a great difficulty; but after a great many experiments a material has been produced which gives satisfaction to all. At present the whole work is done by hand, but we have made exhaustive inquiries into the question of machinery, and that is merely now a question for the near future. No doubt the English doll has still many stages to go through before it reaches perfection, but the first corner has been turned and we now await the co-operation of the British public. It is orders we want, and without this stimulus we cannot hope to improve, nor can we arrive at our main object, namely to establish in this country a new and healthy trade, which will not only be the means of securing permanent employment and good wages for many, but be one of the many factors which shall once and for all obliterate those words—"Made in Germany."

All inquiries should be addressed to The Secretary, British Toy Company, 29, High Street, Stoke-on-Trent.

GLASS RESEARCH.

The Council of the Institute of Chemistry of Great Britain and Ireland have published a short report summarising the work of the Glass Research Committee, appointed in October last, to conduct investigations with a view to arriving at suitable formulas to be freely available to manufacturers willing to assist in maintaining the continued supply of laboratory glassware. The importance of this work to numerous industries, particularly those concerned with the production of war material, will be apparent.

The committee consisted of Professor Raphael Meldola (then President of the Institute), Mr. Bertram Blount, Mr. Otto Hehner, Professor Herbert Jackson, Mr. Walter C. Hancock, and Mr. T. R. Merton. At their first meeting Professor Herbert Jackson reported that, in conjunction with Mr. T. R. Merton, he had already commenced experiments at King's College, London, with a similar object in view, and that he and his collaborator were prepared to give the committee the results of their work up to that date, and to pursue investigations on lines to be determined from time to time by the committee.

Since then the research has been continued uninterruptedly, the chief aims being: (i.) to produce working formulas for all glasses used in laboratory work, and (ii.) to ascertain the influence of various ingredients on the physical and chemical properties of glasses. The work was extended to include glass for miners' lamp-glasses, at the suggestion of the Home Office; and also glass for ampoules, to meet the needs of wholesale pharmaceutical chemists engaged in the production of army medical requirements. The committee have also examined and reported on samples of British and French laboratory glassware, produced since the beginning of the war, a number of the specimens being made from formulas similar to, and in some cases almost identical with, those recommended by the committee.

The committee have had before them many specimens of glasses used for various purposes, of which analyses have been made by Mr. Blount, Mr. Hancock, and Mr. Hehner. It has been found, however, that mixtures prepared in accordance with the analytical results were not always satisfactory; but the analyses were helpful in suggesting synthetic experiments, and during recent investigations some intricate analyses made by Mr. Gilbert J. Alderton, under the supervision of Mr. Blount, have proved especially valuable. Apart from the analyses, the work has been almost entirely carried on at King's College by Professor Jackson and Mr. Merton, and by the former at his own house. The work has involved a careful study of the chemistry of silicates, aluminates, borates, etc., in their relation to the manufacture of glasses. A detailed report of these experiments will be published in due course.

Up to the present time the research committee have reported eleven formulas for glasses for various purposes, based on the results of about 400 experimental melts on a scale large enough for drawing rods and blowing small vessels. In addition, a very great number of experiments have been made in order to study the influence of the various constituents employed. No formula has been issued without submitting the specimens made to rigorous tests to prove their suitability for the purposes for which they are intended. Moreover, by varying the experimental working conditions, it can be said with reasonable confidence that the mixtures will prove equally satisfactory under the actual working conditions of a glass furnace. The question of workable temperatures has been carefully considered, and, so far as it is possible to judge, the melts on a small scale indicate that even better results will be obtained on the industrial scale. This view has been justified by the samples already received from manufacturers who have tried some of the formulas.

In deciding the formulas it has been found

necessary to pay special attention to the proportions of basic and acidic substances in respect of the action of glass mixtures on clay crucibles during fusion, and it has been shown by careful investigation that the formulas proposed give melts in which the influence of the ingredients of the crucibles is very slight, and in some cases practically inappreciable.

The following formulas have been communicated to a number of manufacturers who have expressed their interest in the progress of the investigation, and to scientific workers who are conducting similar experiments:—

Soft glasses, suitable for ordinary chemical laboratory ware:—

	Parts.
(1) Sand	67·0
Sodium carbonate (Na_2CO_3)	34·2
Calcium carbonate	11·6
Alumina (Al_2O_3)	6·5

A soft glass which does not give up alkali readily to water, works well in the blowpipe and does not devitrify readily.

	Parts.
(2) Sand	67·0
Sodium carbonate (Na_2CO_3)	29·0
Calcium carbonate	9·6
Calcium fluoride	1·6
Alumina (Al_2O_3)	8·3
Boric anhydride (B_2O_3)	2·0

A soft glass of higher quality. Does not give up alkali under severe tests. A kindly working glass before the blowpipe, and very difficult to devitrify.

A resistant glass suitable for pharmaceutical purposes, ampoules, etc.:

	Parts.
(3) Sand	67·0
Alumina (Al_2O_3)	10·0
Calcium carbonate	12·5
Magnesia	0·5
Potassium nitrate	1·0
Sodium carbonate (Na_2CO_3)	17·0
Boric anhydride (B_2O_3)	8·0

This glass is intermediate in hardness between soft glass and combustion tubing, is highly resistant to chemical action, withstands changes of temperature well, and should be a very suitable glass for high-class beakers, flasks, etc.

Glasses for combustion tubing:

	Parts.
(4) Sand	68·2
Alumina (Al_2O_3)	6·2
Barium carbonate	8·8
Calcium carbonate	13·0
Potassium nitrate	4.3
Sodium carbonate (Na_2CO_3)	5·5
Boric anhydride (B_2O_3)	5·5
Calcium fluoride	1·0

This glass resembles Jena combustion tubing very closely indeed. It has practically the same fusing point. It fuses on to Jena glass perfectly, and is indistinguishable from it before the blowpipe and in its behaviour on prolonged heating below its fusing point. The presence of the small quantity of calcium fluoride facilitates the incorporation of the ingredients. The sodium carbonate can ber educed to 1·34 parts, provided 7·93 parts of anhydrous borax be used in the place of boric anhydride.

	Parts.
(5) Sand	68·2
Alumina (Al_2O_3)	6·2
Barium carbonate	8·8
Calcium carbonate	14·2
Potassium nitrate	4·3
Sodium carbonate (Na_2CO_3)	5·5
Boric anhydride (B_2O_3)	5·5

This glass is practically of the same composition as No. (4). It is not so easy to make or to work, but it does not become so opaque as Jena combustion tubing on prolonged heating. As in No. (4), the proportions given for sodium carbonate and anhydrous borax can be substituted for the figures for sodium carbonate and boric anhydride

Miners' lamp glasses:—

	Parts.
(6) Sand	65·0
Alumina (Al_2O_3)	1·0
Calcium carbonate	0·6
Arsenious oxide (As_2O_3)	2·0
Antimony oxide (Sb_2O_3)	1·0
Potassium nitrate	3·0
Sodium carbonate (Na_2CO_3)	14·0
Boric anhydride (B_2O_3)	24·0

A colourless and fusible glass withstanding rapid changes of temperature exceptionally well

	Parts.
(7) Sand	65·0
Alumina (Al_2O_3)	1·0
Calcium carbonate	0·6
Arsenious oxide (As_2O_3)	2·0
Antimony oxide (Sb_2O_3)	1·0
Potassium nitrate	3·0
Anhydrous borax ($Na_2B_4O_7$)	26·68
Boric anhydride (B_2O_3)	5·5

The same glass as No. (6), but the ingredients have been varied to avoid the use of so much boric anhydride, which is at present apparently difficult to obtain on a commercial scale.

Resistance glass:—

	Parts.
(8) Sand	65·5
Alumina (Al_2O_3)	2·5
Magnesia (MgO)	5·0
Zinc oxide (ZnO)	8·0
Sodium carbonate (Na_2CO_3)	10·2
Borax anhydrous ($Na_2B_4O_7$)	13·0

A glass almost identical in its general behaviour with Jena resistance glass; withstands changes of temperature well, but, like Jena, is not suitable for working before the blowpipe. It darkens and

tends to devitrify; operations—such, for instance, as sealing side tubes into flasks—are difficult, if permanent and neat joints are required.

Formula No. (3), recommended for pharmaceutical purposes, ampoules, etc., may be substituted for the resistance glass with advantage, as the ampoule glass lends itself very well to blowpipe work, and is also especially resistant chemically.

Alternative for combustion tubing:—

		Parts.
(9)	Sand	72·0
	Alumina (Al_2O_3)	10·0
	Calcium carbonate	11·0
	Magnesia (MgO)	0·5
	Potassium nitrate (KNO_3)	3·0
	Sodium carbonate (Na_2CO_3)	11·2
	Borax anhydrous ($Na_2B_4O_7$)	7·2

This glass is capable of withstanding high temperatures and rapid changes of temperature; works well before the blowpipe and is free from the chief defect of Jena glass, namely, the readiness with which it becomes cloudy and finally quite opaque after prolonged use.

By slight modifications of this formula almost any degree of hardness can be obtained.

In formulas Nos. (8) and (9) substances such as magnesia (MgO) and zinc oxide (ZnO) can be added in the form of carbonates if the actual percentages of MgO and ZnO respectively present in the carbonates are known.

Soft soda-glasses suitable for tubing and for X-ray bulbs:—

		Parts.
(10)	Sand	68·0
	Aluminia (Al_2O_3)	4·0
	Calcium carbonate ($CaCO_3$)	12·8
	Potassium nitrate (KNO_3)	14·5
	Sodium carbonate (Na_2CO_3)	26·0
(11)	Sand	68·0
	Alumina (Al_2O_3)	4·0
	Calcium carbonate	12·8
	Potassium carbonate (K_2CO_3)	10·0
	Sodium carbonate (Na_2CO_3)	26·0

These glasses do not lose their easy-working qualities after repeated heating and blowing, and are plastic over a long range of temperature. They require a temperature of at least 1,400 to 1,500° C. for complete incorporation of the ingredients in order to obtain that homogeneity which is necessary for resistance to rapid changes of temperature and ease of working before the blowpipe.

No. (10), containing potassium nitrate, is considered the better of the two, and is more easily incorporated.

The committee consider that the formulas they have obtained and the work they have done on the various glasses justify them in the opinion that there is now information available for the manufacture of all the important glasses used in the laboratory and for industrial purposes, which have hitherto been mainly obtained from abroad.

THE AIMS AND METHODS OF THE FLY EXHIBITION AT THE ZOOLOGICAL GARDENS.

By L. Henderson Williams.

For some weeks past all the leading newspapers have been preaching on one text—death to the fly. By this time everybody knows that it is righteous to kill flies at sight, but the reasons for this earnest and widespread campaign are not always made so clear as they might be. The Fly Exhibition sets forth circumstantial evidence of the dangerous doings of *Musca domestica* and the blow-flies in ways that cannot be misunderstood, and a visit to the Fly Room in the Zoological Gardens at present cannot fail to afford matter for thought, whether the visitor be an ordinary householder or some one more directly concerned with the public health.

Why the Exhibition was Opened.

All over the country this year there are camps, large and small. The sanitary conditions in them are quite different from urban conditions. There is no water drainage, and the pits, unless very carefully disinfected or otherwise treated, are potential breeding-places of incalculable hordes of flies, besides being attractive to those that do not actually breed in excrement.

Hardly any men are now available for the ordinary removal or dispersion of manurial or vegetable refuse, which will therefore remain, in many places, undisturbed, and in a state particularly favourable to the breeding of flies.

If, in addition, it is realised that pestilence almost inevitably follows war; that there has never been war upon such a scale, nor in which so many countries were involved, in some of which terrible diseases recently were rife; also, that non-biting flies may be of primary importance in the transmission of such diseases as cholera—which may be brought to us by our returning soldiers or by refugees—the necessity for putting the country on its guard against the multiplication of flies will be self-evident. This was the aim which Dr. Chalmers Mitchell and Professor Lefroy had in view in getting up the exhibition.

The Exhibits.

The exhibits may be divided into ten classes. Class I. Things for catching or killing adult flies, such as traps, baits, poisons, sprayers, hand-nets, etc. Class II. Things for killing fly maggots in an early stage in manure or rubbish tips. Class III. Fumigants and disinfectants. Class IV. Proprietary articles, useful in keeping off or killing flies, sent in by inventors or chemists. Class V. Living exhibits illustrating stages in the life-history of flies, and others showing the damage they may do in food, etc. Class VI. Specimens in spirit and pinned flies. Class VII. Models of some bacteria that may be transmitted by flies. Class VIII. Photographs and posters. Class IX. Microscopes and slides illustrative of various points in the structure of flies. Class X. Literature, under which heading comes the most recent research in

fly matters, including the pamphlet written by Professor Lefroy in connection with the exhibition, which is on sale, price 2*d.*, at the Society's offices in the Gardens, and which contains useful information as to how flies carry disease, as well as formulæ of baits and poisons, and directions for setting traps.

Classes V. and VI. will appeal especially to the general public. It is one thing to read or hear that a bluebottle-fly may lay as many as 500 to 600 eggs on a joint if it is left exposed, but it is much more convincing to see the result—500 to 600 maggots squirming in the meat in a horrible fœtid mass.

Again, it not seldom happens that when maids are emptying kitchen waste into the dust-bin they let some small object drop and remain outside. One exhibit shows a dish of such ordinary things—a fresh haddock's head, a marrow-bone, whelk shells, a dead mouse, etc.—which were exposed for a day, or a few hours, and all of which are fly-blown.

The books and microscopes are primarily intended for the use of medical men and public health officers, who will ultimately be responsible for fly control throughout the country.

ADVICE.

The object of the Fly Exhibition is to be useful. It is not contended that it, in its early stage, is a repertoire of all wisdom pertaining to the extermination of flies; nor has it yet by any means reached its possible limit in the matter of exhibits, but it may claim, even now, to be a centre for the diffusion of knowledge, and to be useful, in some direction, to all classes of the community, from the farm labourer to the factory owner.

The abnormal rise in price of many chemicals has made it impossible to recommend as practicable sundry treatments as, for instance, the borax treatment of manure, which, in ordinary times would be strongly advocated. Whenever possible, substitutes are put forward and general advice is given, such as keeping manure covered and darkened to prevent the access of flies, keeping it comparatively dry to prevent their breeding, etc.

Investigations are being conducted the results of which are not yet ready for communication, but which, it is hoped, will make the exhibition increasingly valuable as time goes on. Meanwhile, co-operation is invited from all those practically concerned in fighting flies.

ENGINEERING NOTES.

Big Guns.—"This war has brought home to us the necessity of being ready for war," said Lieut.-Colonel A. G. Hadcock, of Armstrong, Whitworth, and Co., Ltd., at a meeting of the Royal Institution. Lieut.-Colonel Hadcock said the manufacturing capacity of the country had been strained to its utmost. We had to make guns and ammunition in a few months over which other nations had taken the same number of years. Referring to big guns, the speaker said few people were aware of the extensive knowledge of science and art necessary to construct a gun and mounting. In the construction of some guns wire was wound round them, and in a 12-in calibre gun the length of this wire was about 130 miles, and in a 13-in. calibre gun about 140 miles, while in some of the latest guns the length of the wire exceeded 190 miles. Guns were often found to become gradually longer after continual firing. The longer a gun was the quicker it would wear out. The life of a gun depended greatly on the heat of the powder.

The 125-lb. per yard Rails for the Pennsylvania Railway.—The increased weight of American locomotives and their heavier wheels need a corresponding advance in the strength of the rails. It was originally proposed to have a 120-lb. rail instead of a 100-lb. rail, but a little later the company decided to make trials of an unprecedented 125-lb. rail, the change being necessitated by the desire to have a rail which would have a moment of inertia as near 70 as possible. The new 125-lb. rail is, of course, experimental in character, and various steel companies are now rolling small orders. The height is $6\frac{1}{2}$ in. against $5\frac{11}{16}$ in the 100-lb. section; the width of the base is $5\frac{1}{2}$ in. compared with 5 in. The top of the head has a radius of 12 in. instead of one of 10 in. in the 100-lb. rail, and the corner radii are $\frac{7}{16}$ in. in each case. The fishing angles are 18° for the head and 14° for the base, compared with 15° and 13° respectively for the older rail.

Train Dispatch by Telephone. Some years ago, the *Engineer* noted the adoption of this system on the Canadian Pacific Railway. The experiment was tried five years ago on a short run between Montreal and Farnham. To-day, on six thousand miles of the Canadian Pacific Railway, the telephone has wholly superseded the telegraph system for dispatching, and the system is being extended to include the whole of the railway lines and branches. The accuracy, promptitude, and efficiency obtained by the use of the telephone are remarkable. The initial cost of installation is greater than that of the telegraph, but the general superintendent of car service states that the increased efficiency more than offsets the increased cost. On each passenger and freight train there is a portable telephone, which in case of emergency can be attached and connected with the nearest dispatcher's office without delay. In this way the train is never beyond instant connection with necessary authority and help, whereas with telegraphy a skilled operator is always necessary, even with portable apparatus. In ordinary dispatching, where accuracy is of such vital importance, the telephone has a decided advantage. With the telephone there is no delay, no uncertainty, and the train is never beyond the reach of the dispatcher.

Cement Manufacture in India.—We are accustomed to connect Greater Britain with raw materials alone, but the Colonies and India are not only hewers of wood and drawers of water, as the steel from Canada and Australia, and the cotton mills of India remind us. Amongst these industries will be shortly included the making of Portland cement in India. The plant is the property of the Katni Cement and Industrial Co., Ltd., and is expected to turn out from 30,000 to 35,000 tons of cement per year. This will be manufactured by the wet process in rotary kilns driven by electric power. In addition to the cement works, the same company has erected works for the manufacture of roofing, ridge and ceiling tiles, glazed wall and flooring tiles, fire-bricks, glazed drainage pipes, glazed earthenware troughs for carrying electric cables, acid-proof jars, and a number of hospital necessities.

A Large Direct-current Generator. The *Electrical World*, in a recent issue, gives a short description of an exceptionally large generator, built by the Crocker-Wheeler Company, for the Ford Motor Company at Detroit. The maximum rated output is 4,500 kilowatts at 80 revolutions per minute. The output, of course, is large for a direct-current generator, but it is not a record. Owing, however, to the very low speed, the dimensions of the machine are exceptional. The total weight, including shaft, is about 135 tons. The outside diameter of the frame is 22 ft. 6 in., and the distance across the base 25 ft. 8 in. There are thirty main poles, and thirty inter-poles bolted to the inside of the magnet frame. In building the machine, the makers had to consider the question of transporting it to its destination, and the casting had to be split, in order that it might pass through the railway tunnels.

The Panama Canal Defences.—The following particulars are from a lecture delivered by Major E. P. O'Hern, at the Coast Guard Artillery School, Fort Monroe, Virginia, of which a summary is given in the *Journal of the United States Artillery*. The Panama Canal defences will embody 16-in. and 14-in. guns, on disappearing carriages, 12-in. mortars and 4·7-in. howitzers. The 16-in. gun of 35 calibres has a range of 18,600 yards, at 15° elevation. It will be mounted at a considerable height above sea-level, which will increase the range. The weight of the projectile fired by this gun is 2,400 lbs., the weight of the charge being 660 lbs. The 14-in. guns are 40 calibres long, and have a muzzle velocity of 2,360 ft. per second and a range of 19,360 yards. These are wire-wound guns, with jacket and B. tube of nickel steel. The weight of the projectile is 1,660 lbs. The 12-in. mortars are wire-wound. They have a muzzle velocity of 1,800 ft. per second, and a range of 19,000 yards, and are the largest pieces of ordnance of this class so far employed in the United States defences. The 4·7-in. guns are primarily intended for the defence of the locks, but extra pedestal mounts will be supplied at the ends of the Canal, so that they may be quickly concentrated at either terminal. These howitzers fire 60-lb. shrapnel, and have a muzzle velocity of 1,300 ft. per second, and a range of 10,000 yards.

Buffer Stops: a Frictional Device.—Buffers of various types have been employed to bring a train entering a terminal station at an excessive speed to a stop, but the *Times Engineering Supplement* states that the problem of design is complicated by the fact that, while the buffer must be capable of stopping the train, the result must be accomplished without serious damage to the buffer itself or harm to the train. A buffer recently invented in America is not secured rigidly to the rails at their ends, but is designed to slide upon them when the momentum of the train exceeds a certain predetermined amount. The essential portion of the buffer consists of two long shoes or tapered friction rails that rest upon the track. The train rides upon these shoes and strikes a plunger projecting from a pneumatic cylinder if it is not stopped in time. The air cushion behind the plunger is relied upon to retard the train's motion, but if it is unable to do so the whole buffer slides along the rail until the friction between it and the rails is sufficient to overcome the momentum of the train. In a test of this buffer a train weighing 1,000 tons, and travelling at a speed of three miles an hour, was brought to a standstill without displacing the buffer. At four miles the buffer slid nine inches, and at eight miles the displacement of the buffer was three feet, and at thirty-two miles, forty feet.

The Corrosion of Condenser Tubes.—Mr. E. Bates, White Bay Power-house, Sydney, N.S.W., has sent to *Engineering* a copy of a paper on this subject, read by him before the Electrical Association of New South Wales in 1913. In this paper Mr. Bates states that the exceedingly serious corrosion of condenser-tubes experienced at the Ultimo Power-station of the Sydney Tramways had been completely checked by the simple procedure of painting the whole of the interior of the cast-iron water-boxes with an anti-corrosive paint. Following the success at Ultimo, the same procedure was adopted with equally good results at the power-station of the Adelaide tramways, where much trouble had been experienced from condenser-tube corrosion. Similar expedients, including electrolytic methods, which failed after a time, were tried. It is therefore interesting to learn from Mr. Bates that his system is still in use at the Sydney power-stations, and with excellent results. During the fifteen months which have elapsed since his paper was read, the number of tubes removed from the two older 5,000-kilowatt condensers has, Mr. Bates informs us, not exceeded three per month, whilst before the Bates' method of protection was adopted it was not uncommon to lose 150 tubes from one condenser in a single week.

OBITUARY.

George Frederick Pollock. — Mr. George Frederick Pollock died at his residence at Hanworth on the 19th inst., at the age of ninety-four. Born in 1821, the third son of the late Lord Chief Baron Pollock, he was educated at King's College, and called to the Bar in 1843. For nearly fifty years he was a Master of the Exchequer Court and Supreme Court, and King's Remembrancer.

In addition to his legal knowledge, Mr. Pollock was well versed in many branches of science. He was deeply interested in mechanics, and before he left the Bar he had become well known as an arbitrator in patent cases. He made a close study of watches and clocks, and did some excellent work as an astronomer. The *Times* recalls the fact that he was asked by his friend, John Murray, to read "The Origin of Species" as it passed through the press, and it was on his advice that Murray doubled the edition.

Mr. Pollock was elected a member of the Royal Society of Arts in 1905.

John Edward Parsons. -Information has been received of the death of Mr. John Edward Parsons, which took place on January 15th. Mr. Parsons was born at New York in 1829, and after being educated at New York University he was called to the Bar in 1852. He occupied a number of important positions: he was director of the Metropolitan Trust Company, a trustee of the Bank for Savings, President of the Women's Hospital, of the General Memorial Hospital, and of the Cooper Union for the Advancement of Science and Art. He took a deep interest in the work of a number of American learned societies, including the American Museum of Natural History and the Metropolitan Museum of Art. He was elected a member of the Royal Society of Arts in 1906.

GENERAL NOTES.

Medicinal Plants.—Fifty years or so since, at Milcombe and Bodicote, says the *Banbury Advertiser*, plants used in medicine were cultivated —rhubarb, henbane, the poppy, and roses—with some amount of success. Plants used in dyeing —woad, the dyers' rocket and others—lost place long years before that. Amongst the bitter lessons of the war is the failure of the foreign supplies which had displaced the British products. Hence we read that prices have risen twice or three times above normal value, and sufficiency of supply becomes a matter of grave concern. Amongst the plants mentioned by Mr. W. A. Whatmough (Journal of Board of Agriculture, September, 1914) are aconite, anise (grown at Westington, near Chipping Norton), belladonna, caraway, chamomile, coriander, dandelion, foxglove, dill, golden seal, valerian, rhubarb, henbane and poppy, elder, coltsfoot, mullein, marshmallow, and tansy are mentioned amongst a number of other plants now likely to be in demand in the market. Some useful notes on cultivation and the necessary form of preparation for the market are added in the account written. It should not be forgotten that the Botanic Garden (the old physic garden) at Oxford is open to everyone, and that most of the plants named, with the many species of like kind grown in other parts of the world, are to be seen, each kind bearing its name and country. Mr. John Tustian, of Milcombe, and Mr. Rufus Usher, of Bodicote, were growers of medicinal plants in the last century, and previously to that, the Society of Arts awarded two medals, a silver one in 1789, and a gold one in 1794, to William Hayward, of Banbury, for growing rhubarb.

Telephone Troubles in the Tropics.—In a paper recently read before the Institution of Electrical Engineers, Mr. W. Llewellyn Preece described some of the serious difficulties met in telephone engineering in tropical countries. The main troubles are due, not to the heat, but to the damp, and the many natural effects caused by damp heat, the humidity of the atmosphere in many places varying between 80 and 90 per cent. This damp heat produces a marvellous growth of vegetation, so thick that along the sides of country roads there are actual walls of green leaves, perhaps 80 or 100 ft. high, the growth of which is so rapid that they may be cut back one day and grow as high again in the ensuing twenty-four hours, while insect life is as prolific as the vegetation. Lightning, again, has a virulence unknown in this country, and even the wild animals do their best to increase the engineers' difficulties. In some parts, for instance, it is not unusual to have a mile or two of lines wrecked by giraffes, elephants, or monkeys. When the giraffes roaming over the wilds of East Africa come up against a telegraph or telephone line, they have not the sense to draw back or duck their heads, but push on, carrying wires and sometimes poles with them.

Mica in Canada.—Canada is one of the three principal mica-producing countries of the world, the others being India and the United States. The average value of the mica produced annually in Canada during the last ten years has been about $185,000. With the possible exception of Ceylon, Canada is the only country, as far as is yet known, in which the variety phlogopite—or "amber mica," as it is termed in the trade—is known to occur in economic quantities. The mica of commerce is of two kinds—muscovite, or "white mica," and "amber mica." The former commands rather the higher price, as it is softer and more flexible, and generally more suitable for use as an insulator. The Canadian amber deposits, according to the report of the Canadian Department of Mines, are comprised within an area of about 1,200 square miles in the province of Quebec, and 900 square miles in the province of Ontario. The city

of Ottawa, which lies between the two areas, is the seat of the mica industry, and contains all the important works engaged in trimming and preparing the mineral for the markets. The average dimensions of mica sheets do not much exceed 3 ins. × 5 ins., but occasionally plates of enormous size are found. Crystals have been obtained measuring over four feet across, and weighing nearly two tons.

COTTON IN UGANDA.—The cotton industry of Uganda has continued to make remarkable progress. The annual report of the Department of Agriculture states that the area under cotton in 1913-14 amounted to 83,714 acres. The exports were 85,217 cwts. of ginned cotton, valued at £272,366, and 44,130 cwts. of unginned cotton, valued at £45,321. The whole of the main crop of the season was Allen's Long Staple variety. During the present season the same variety is being grown over the greater part of the country, but about 6,000 acres will be planted with a selection of the Sunflower variety produced at the Kadunguru seed farm.

MOVEMENT OF SHIPPING AT THE PRINCIPAL ITALIAN SEAPORTS, 1914.—The total net tonnage of the shipping which entered and cleared at the seventeen principal Italian ports during 1914 is given in an official report recently published by the Minister of Commerce. The ports classed as principal, and given in alphabetical order, are: Ancona, Bari, Brindisi, Caglieri, Catania, Civita Vecchia, Genoa, Leghorn, Messina, Naples, Palermo, Porto Empedocle (Girgenti), Savona, Spezia, Torre Anunziata, Trapani, and Venice. The following figures show the net tonnage of the vessels which entered and cleared at these ports in 1914 as compared with the previous year:—

	1914.	1913.
Entered . .	34,645,000 tons.	39,789,000 tons.
Cleared . .	34,581,000 „	30,898,000 „
Total . .	69,226,000 „	70,687,000 „

showing a decrease of 1,861,000 tons lost as compared with the previous year. The total tonnage of goods handled at those ports during the two years was -

	1914.	1913.
Landed . .	16,121,000 tons.	18,208,000 tons.
Shipped . .	3,830,000 „	4,378,000 „
Total . .	19,951,000 „	22,586,000 „

or 2,635,000 tons less last year than in 1913, chiefly noticeable in the imports.

INCREASING REVENUE OF THE FRENCH CUSTOM HOUSE.—It is satisfactory to note a progressive improvement in the monthly receipts of the French Custom House since the beginning of the current year. In fact, compared with those of the corresponding months of last year, the receipts last January, which had fallen as much as 27 per cent. below those in 1914, and 24 per cent. in February, decreased to only 20 per cent. in March. This is satisfactory evidence of improving trade conditions at the present time.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 31...Surveyors' Institution, 12, Great George-street, S.W., 5 p.m. Annual General Meeting.

Geographical Society, Burlington-gardens, W., 8.30 p.m.

TUESDAY, JUNE 1...British Decorators, Institute of, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Paper by the late Mr. W. G. Sutherland, on "Some Aspects of the Recent Enquiry into the Use of Lead in the Painting of Buildings," to be read by Mr. A. G. White

Royal Institution, Albemarle-street, W., 3 p.m. Professor J. O. Arnold, "The Evolution of Steel: Influence on Civilisation." (Lecture I.)

Alpine Club, 23, Savile-row, W., 8.30 p.m. Rev. W. Weston, "Mountaineering in Japan."

Rontgen Society, Cancer Hospital, Fulham-road, S.W., 8.15 p.m. Annual General Meeting.

Gas Engineers, Institution of, Southport Annual General Meeting, from June 1st to 4th.

WEDNESDAY, JUNE 2...Public Analysts, Society of, at the Chemical Society, Burlington House, W, 8 p.m. 1. Messrs. C. Revis and H. R. Burnett, "The Estimation of Starch in Cocoa by the use of Taka Diastase." 2. Mr. B. Campbell, "The Volumetric Estimation of Ferrocyanides." 3. Mr. Seiichi Ueno, "Corean Beeswax." 4. Mr. R. Bodmer, Determination of β-Naphthol in Lysol and similar compounds." 5. Mr. J. J L. van Ryn, "The Composition of Dutch Cheese."

Royal Archæological Institute, at the Society of Antiquaries, Burlington House, W., 4.30 p m. Mr. C. H. Bothamley, "Carcassone · the Cité and the Basse-ville."

THURSDAY, JUNE 3...Linnean Society, Burlington House, W., 8 p.m.

Chemical Society, Burlington House, W., 8 30 p.m. 1. Messrs. H. Hollings and J. W. Cobb, "A thermal study of the carbonisation process." 2. Messrs. T. M. Lowry and R. G. Parker, "The properties of cold-worked metals. Part I.—The density of metallic filings."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. W. Ward, "Methods of Presenting Character in Biography and Fiction." (Lecture I.)

FRIDAY, JUNE 4...Royal Institution, Albemarle-street, W., 9 p.m. Professor Sir E. Rutherford, "Radiations from Exploding Atoms."

Geologists' Association, University College, W.C., 8 p.m.

Municipal and County Engineers, Institution of, County Hall, Ayr, 11 a.m. Discussion on the following papers: 1. Mr. J. Bryce, "Suggested Town-Planning Details for Scottish Conditions, with criticisms by some members of the Town-Planning Committee of the Scottish District." 2. Mr. J. McFadzean, "Pressure Scraping 15 miles of Water Main."
2.30 p.m. Discussion on the following papers: 1. Mr. R. Drummond, "Road Work." 2. Mr. A. Stevenson, "Description of Experimental Stretches of Road laid in the Ayr District, Ayr County, and Meteorological Station in connection therewith." 3. Mr. W. A. Macartney, "Municipal Housing." 4.15 p.m. Visits to Municipal Works, etc.

SATURDAY, JUNE 5...Royal Institution, Albemarle-street, W., 3 p.m. Professor R. S. Rait, "Mary, Queen of Scots, and Queen Elizabeth." (Lecture II.)

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FRIDAY, JUNE 4, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

PROCEEDINGS OF THE SOCIETY.

SPECIAL LECTURE.

A meeting of the Society was held on Thursday, May 6th, 1915; LORD SANDERSON, G.C.B., K.C.M.G., in the chair.

THE CHAIRMAN, in opening the meeting, said that about two months ago the Society took advantage of the presence in this country of M. Paul Lambotte, the Director of Fine Arts of the Ministry of Sciences and Arts of Belgium, to offer him an invitation to deliver the Aldred Lecture. He was good enough to accept the invitation, and chose as the subject of his lecture the development of the Belgian school of painting. He (Lord Sanderson) had the honour of taking the chair on that occasion, and he felt at the time that, interesting as the lecture was, it would not be altogether complete unless on a future occasion a supplementary lecture was delivered upon the modern school of Belgian sculpture, a school which was quite as important as the school of modern Belgian painting. He would never have thought of suggesting that M. Paul Lambotte should come again to the Society for that purpose, but M. Lambotte had been kind enough to volunteer to do so, and the Society was again honoured by his presence. They were greatly indebted to him for his kindness.

The lecture delivered was—

CONSTANTIN MEUNIER ET LES SCULPTEURS BELGES DE SON TEMPS.

Par PAUL LAMBOTTE,

Directeur des Beaux Arts au Ministère des Sciences et des Arts de Belgique.

Mesdames, M. le Chairman, Messieurs,—

Le 11 mars j'ai eu l'honneur d'entretenir les membres de la Royal Society of Arts de " L'Évolution de la Peinture en Belgique " au cours du dix-neuvième siècle. Il m'a paru que cet essai exigeait un pendant, c'est-à-dire une causerie consacrée à la sculpture de notre pays pendant la même période. Je m'en suis ouvert à Sir Henry Trueman Wood, qui a bien voulu entrer dans mes vues. C'est, je crois, un devoir patriotique de tâcher de mettre en lumière notre belle école de sculpture, dont la notoriété a franchi les limites de notre territoire exigu. J'ai pris comme titre de cet entretien " Constantin Meunier et les sculpteurs belges de son temps " parce que la grande figure de Constantin Meunier domine toute notre école et que son œuvre est connu et apprécié universellement. Mais, fidèle au plan qui a guidé mon travail la première fois, j'entends bien encore ne pas isoler Constantin Meunier de tous ceux qui ont préparé, accompagné ou suivi l'épanouissement de son art. Ma tâche sera moins compliquée que pour les peintres, le nombre de nos sculpteurs de marque étant moins considérable, et je pourrai me donner le plaisir de m'attacher un peu plus à chaque personnalité.

La sculpture est un art austère dont le développement est plus lent que celui de la peinture. Une école de sculpture atteint sa période d'efflorescence après que la peinture, dans la même contrée et dans les mêmes conditions de prospérité, est déjà en plein épanouissement. La sculpture est associée à l'architecture Elle lui est d'abord subordonnée. A la longue seulement elle prend une vie propre, distincte. L'œuvre d'art de petites dimensions, destinée à l'ornement de la vie, convenant au goût de l'amateur, est, de préférence, une " chose encadrée " qui se suspend aux parois de la maison. Peu de personnes vont au delà, franchissent le pas qui les amènerait à la compréhension de l'œuvre sculpturale. Cette œuvre, privée des prestiges d'une harmonie de couleurs flatteuses, éloquente par les beautés moins apparentes du galbe, des plans, des volumes, demeure froide et indéchiffrable aux yeux du plus grand nombre. C'est à peine si de temps en temps le buste de marbre, de bronze ou de terre-cuite est préféré au portrait peint, et cette préférence est déjà une indication de culture

artistique plus complète ou de goût instinctif plus affiné. Non pas que je veuille dire qu'une hiérarchie fasse prédominer la sculpture, et j'aime mieux un beau portrait qu'un buste médiocre, mais j'entends que la foule est en somme accessible à la peinture et que la sculpture lui demeure plus impénétrable.

Les œuvres des statuaires, par leur poids, par leur importance, sont peu mobiles. Elles sont malaisées à emballer, à expédier, à exposer. Celles qui remplissent un rôle monumental sont immeubles par destination. La participation des sculpteurs aux expositions est toujours difficile, restreinte, coûteuse. C'est pour ce motif que nos sculpteurs sont moins célèbres à l'étranger que nos peintres et c'est aussi pour ce motif qu'il est désirable de les faire mieux connaître.

Constantin Meunier est une exception, et il a fallu des circonstances spéciales, et même un peu de chance, pour que, de son vivant, il fut réputé hors de Belgique. Ses collègues n'ont pas eu la même bonne fortune.

Heureusement j'ai pu réunir un bon nombre de projections qui vont défiler devant vous sur cet écran. Elles illustreront mes commentaires et vous pourrez associer des œuvres avec les noms de leurs auteurs et les détails que je vous fournirai. Si ingrate pour la peinture—qu'elle prive du charme de la couleur, son principal attrait,—la photographie rend mieux justice à la sculpture. Je pourrai vous montrer des aspects assez représentatifs d'œuvres intéressantes. Sans doute vous ne pourrez juger les divers aspects et les éclairages que chaque aspect comporte; il faudra vous contenter de silhouettes, de formes immobiles, alors qu'en tournant autour d'une œuvre le spectateur, par le jeu des ombres et des lumières et le mouvement des plans, peut au contraire faire bouger et vivre la forme.... Mais votre imagination devra suppléer à ces empêchements matériels.

J'ai, l'autre jour, commencé l'histoire de la peinture belge au moment où la Belgique, en 1830, s'est constituée en royaume indépendant.

L'histoire de la sculpture peut être traitée parallèlement. Toutefois nous avons eu à Bruxelles, tout à la fin du dix-huitième siècle, un statuaire de grand talent, Godecharle, auquel l'école qui va suivre doit évidemment beaucoup. Je ne vais pas consacrer une étude à Godecharle, qui eût une éducation complexe et trahit une heureuse assimilation d'influences différentes, mais je tiens à prendre son nom comme point de départ, avant de citer ceux des plus anciens de nos statuaires, Mathieu Kessels, Joseph et Guillaume Geefs, Eugène Simonis, Charles Auguste Fraikin, pour ne parler que des plus intéressants.

Ces artistes ont orné nos monuments de groupes et de statues. Kessels n'est guère sorti des froids pastiches de l'antique, mais nous devons aux deux Geefs, à Simonis et à Fraikin quelques ouvrages qui ne sont point négligeables.

C'est Guillaume Geefs qui est l'auteur de la statue du Général Belliard placée rue Royale à Bruxelles, à laquelle le panorama de la ville basse met un si beau décor de fond. C'est lui aussi qui a modelé les groupes de la Place des Martyrs, le Mausolée de Frédéric de Merode à Ste Gudule, et plusieurs effigies de Léopold Ier.

Eugène Simonis est l'auteur de la belle statue équestre de Godefroid de Bouillon, des lions qui sont à la base de la Colonne du Congrès, des frontons du Théâtre de la Monnaie.

Et Fraikin nous a donné le monument d'Egmont et de Hornes qui fut longtemps devant la Maison du Roi, Grand' Place, et fut, lors de la restauration de ce délicieux immeuble, transféré au square du Petit Sablon, à l'ombre de quelques arbres.

Ces ouvrages ne demandent pas à être vus de près. On leur réclamerait en vain de la sensibilité de surface, de la saveur d'exécution, de l'agrément en tant que morceaux. Mais ils font bien où ils sont, dans le décor. Ils ont l'ampleur et les silhouettes nécessaires.

C'est en somme de la sculpture qui "remplit des contours," qui est contenue dans un galbe, avec froideur et classicisme, un académisme inspiré des répliques romaines de beaux originaux grecs.

Nous pouvons ne pas nous attarder beaucoup et arriver tout de suite à des artistes plus intéressants.

Je nommerai Paul Bouré, sans m'arrêter, mais je veux attirer votre attention sur les œuvres d'un homme qui fut le premier en Belgique à faire passer dans l'art de la sculpture un frisson de modernité, à donner au travail de chaque surface une valeur précieuse, un intérêt d'exécution.

Paul De Vigne occupe dans notre école une place isolée. Il est comme l'aboutissement de tendances diverses, d'influences étrangères et locales un peu contradictoires: il est classique et très moderne en même temps, il a le goût de la beauté, l'instinct des formes harmonieuses et pures, et il mêle à cela un sens ardent de la vie, une compréhension toute contemporaine du mouvement, de l'action, du transitoire dans le geste souple et coulant.

Formé par l'étude des statuaires florentins, il fait penser parfois à leur élégance, à leur eurythmie. Ses statues, ses bustes de femmes, d'enfants, ont des précurseurs dans l'œuvre d'un Verrocchio, d'un Donatello, mais si nous les examinons de plus près nous constaterons combien chez De Vigne le souci de la forme immobile a fait place au culte de la vie. Les yeux, les bouches sont traités comme par un peintre, dans un parti pris expressif, qui prévoit le jeu de la lumière sur le contour, l'animation du mouvement rendu par des contractions, un jeu de surfaces lisses ou gonflées, frissonnantes et frémissantes, qui déjà annonce Rodin.

Si Paul De Vigne modèle des figures populaires, des types réalistes d'énergie ou de souffrance, il atteint à l'effet par des moyens simples et sobres, une parfaite entente des volumes et de la succession des plans, à laquelle se reconnaît immédiatement le grand sculpteur instinctif et doué.

J'ai cité Rodin tout à l'heure. Il sut apprécier le talent de Paul De Vigne, qui était son ainé de pas mal d'années et il a exécuté de lui un buste magnifique, un buste extraordinaire, exprimant toute la vie pensive de l'artiste par l'ampleur lumineuse d'un front exalté.

Paul De Vigne fit sa carrière à Rome, à Paris et à Bruxelles. C'est à Bruxelles qu'il avait son atelier et qu'il travaillait d'ordinaire. Il naquit à Gand, et sa ville natale a tenu à le glorifier en même temps qu'un autre enfant de la vieille cité flamande, Liévin de Winne, admirable peintre de portraits qui fut l'ami de Paul De Vigne.

A la mémoire de ces deux maitres belges fut érigé au Musée de Gand un mémorial composite tout à fait touchant.

Il est surmonté d'une réplique de la belle statue de "L'Immortalité" que De Vigne avait dédiée au peintre et dont le marbre original est au Musée de Bruxelles. De chaque côté du piédestal sont les bustes des deux artistes— Paul De Vigne par Rodin, Liévin de Winne par Paul De Vigne. Ainsi, unis dans une glorification émouvante et posthume, les deux maitres sont associés pour la postérité.

Paul De Vigne est l'auteur de groupes importants, celui de Breydel et de Koninck érigé à Bruges, d'une belle allure populaire sans aucune vulgarité ; celui qui symbolise "Le Génie de l'Art" sur la façade du Musée Ancien de Bruxelles, avec beaucoup de style et de noblesse ; mais il est surtout lui-même dans une série de délicieux bustes de femmes, d'enfants, d'adolescents, où son instinct de la beauté l'a conduit à des réalisations exquises, sans fadeur ni mièvrerie, et d'une technique admirable.

Parmi les contemporains de Paul De Vigne trois sculpteurs belges, disparus comme lui, méritent une étude: Julien Dillens, Jef Lambeaux, Charles Van der Stappen.

Julien Dillens n'a pas donné toute la mesure de ses dons et n'alla pas jusqu'au bout de son développement. Il fut un malchanceux de la vie et mourut d'ailleurs prématurément, ou du moins sans avoir réalisé, dans la mesure du possible, son idéal. Dillens était spécialement doué pour la décoration monumentale. Toutes les figures qu'il a créées pour les associer à l'œuvre d'architectes furent pittoresques et bien trouvées. Elles ont la proportion, l'harmonie, les lignes qu'il fallait pour "tenir" à leur place et parer une façade ou une attique. Il avait de l'imagination, du savoir faire, il savait improviser des formes heureuses et ornées, avec fantaisie et avec goût. Dillens a modelé des statues et des cariatides pour de nombreux édifices à Bruxelles. Il est aussi l'auteur de belles figures funèbres, de nombreux portraits. On cite parmi ses œuvres les plus heureuses: le groupe "La Justice," "Le silence de la tombe," "Génie funèbre." Mais il a aussi aimé la joie et réalisé des œuvres d'une inspiration bien différente—"L'Allegretto," entre autres.

Jef Lambeaux a joui en Belgique d'une notoriété extrême, et jusqu'au moment où Constantin Meunier fut enfin admis et consacré, il était certes le plus populaire de nos sculpteurs. Anversois comme Dillens, Lambeaux eut des débuts éclatants, et dans quelques morceaux— "Le Baiser," qui est au Musée d'Anvers—ou la fontaine de Brabo—ou le buste magistral intitulé "Imperia"—il sut allier une extrême liberté de mouvement avec la saveur du métier et l'entente grandiose des plans ménageant des coulées de lumière et d'ombres.

Sa gloire fut telle un moment que le gouvernement belge lui commanda, d'après un carton qu'il avait composé, un énorme bas-relief de marbre représentant "Les Passions Humaines." Un édifice fut érigé tout exprès pour abriter l'œuvre dans le Parc du Cinquantenaire à Bruxelles.

Il y eut des démêlés vaudevillesques, d'ailleurs, entre le sculpteur, l'architecte, de très grand talent, chargé des plans de la construction, et le gouvernement, qui, après avoir commandé l'œuvre, s'effraya de son audace et tint longtemps l'édicule achevé fermé aux visiteurs.

C'est une œuvre étrange, mal composée sans doute, où les passions charnelles semblent

prédominer absolument sur les intellectuelles, mais dont certains morceaux sont absolument remarquables. Je rappelle aussi le " Dénicheur d'Aiglons," un succès de la jeunesse de Lambeaux.

On a de lui plusieurs groupes de " Lutteurs," très véhéments.

En vieillissant l'artiste se laissa entraîner à une préoccupation un peu exclusive de sujets lascifs et débridés. Son " Ivresse," sa " Folle Chanson," son " Faune Mordu," et d'autres, plus petits d'échelle et d'allure commerciale, ont fait scandale sans que toujours leur mérite de composition ou de modelé put compenser leur licence. La verve de Lambeaux semblait devenue un peu artificielle et voulue, sa force tournait à l'enflure, à la déclamation. Quand on voulut faire une exposition posthume de ses œuvres dans le but pieux de le bien glorifier en ne mettant sous les yeux du public que de très bonnes choses, je dois convenir que la tâche parut ardue et le choix très limité, mais il reste quelques ouvrages de lui qui sont tout à fait de premier ordre et bien personnels.

Chez Charles Van der Stappen la personnalité fut moins marquée, et l'on sent du flottement entre des influences diverses. Revenu ébloui d'Italie il créa d'abord des statues d'allure presque florentine : son " Jeune Homme à l'Epée," du Musée de Bruxelles, son " David "— pour arriver peu à peu, sous l'influence évidente de divers confrères : Lambeaux, quand il compose le groupe de lutteurs intitulé " Ompdrailles " (d'après le roman de Cladel) : Dillens, quand il improvise une décoration pour une pièce d'eau à l'exposition de 1897 à Bruxelles (non exécutée et détruite) : mais surtout Constantin Meunier, quand il entreprend un monument à "L' Infinie Bonté." Il fait aussi penser parfois au sculpteur français Jean Carriès. Van der Stappen est personnel dans quelques très beaux bustes, portraits pleins de vie et d'accent, les meilleurs morceaux qu'il ait signés, " Le Poete Verhaeren," " La Zélandaise," " M. Philippson père," " Le peintre Sacré."

Ces trois artistes furent des contemporains de Constantin Meunier et furent un peu rejetés dans l'ombre quand enfin le succès vint à ce maître.

Vous n'ignorez pas, mesdames et messieurs, que Constantin Meunier est arrivé très tard à la gloire. Il a longuement lutté dans l'isolement et dans l'incompréhension avant d'être enfin apprécié. Il a fait, pendant des années, de la peinture, cherchant sa voie, intéressant certes par la portée morale de ses œuvres, mais incomplet, incertain, tentant des essais divers. On a de lui " L'Enterrement d'un Trappiste " (Musée de Courtrai), " St. Sébastien," " Le Martyre de St. Étienne " (Musée de Gand), " La Salle St. Roch."

Sous l'influence de Charles Degroux Meunier s'était consacré aux sujets exaltés et pénibles. Son art était sévère, rebutant, malgré la grande bonté compatissante qui l'inspirait toujours.

En 1880 Meunier peignit pour une décoration éphémère de salle de fêtes un grand panneau, " La Fonte de l'Acier," qui semble avoir enfin fixé et orienté sa carrière.

Camille Lemonnier avait annoncé qu'après J. F. Millet, le premier interprète sincère et ému du paysan, l'ouvrier des usines trouverait à son tour son peintre. Camille Lemonnier a certes, avec la divination d'un grand critique d'art, aidé Constantin Meunier à découvrir enfin et à creuser son propre sillon. Lemonnier a conté cet épisode que je vous demande la permission de vous lire :

" Constantin Meunier approchait de la cinquantaine quand je le connus. Sa vie avait été rude, secouée d'assauts. Il penchait déjà cette épaule sur laquelle depuis pesèrent la douleur et le travail. Un art sévère mais sans gloire le vouait à une destinée qui tardait. J'eus la pensée de lui demander des dessins pour les chapitres de ma ' Belgique ' sur la contrée industrielle." (Ceci est une inspiration admirable de l'homme de lettres, en quelque sorte le coup de pouce de la destinée pour l'artiste. Mais je laisse la parole à l'auteur :) " Son âme grave et pitoyable prit ainsi contact avec le Pays Noir, comme le premier je l'appelai. Un jour nous montâmes à la terrasse du château de Mons. Sous un lent et incessant déluge de charbon l'air s'estompait de teintes fuligineuses qui décoloraient la tiède après-midi. Une suie éternellement projetée des hautes cheminées recouvrait dans un remous d'incessantes fumées des campagnes anémiques et dévastées. La sensation fut si forte de nous trouver brusquement devant ces horizons calcinés au bas desquels en tous sens s'étageaient des buttes sombres, que nous demeurâmes longtemps sans parler. C'est que de l'endroit élevé d'où nous dominions la grande plaine s'apercevait le cœur même de la région charbonnière.

" L'artiste, qui allait devenir le pensif et sensible introducteur des plèbes dans l'art, à peine connaissait le pays pathétique qui devait être pour lui la cause d'une expression nouvelle d'humanité. Ce moment, dans sa vie, eut une gravité émouvante. Il décida de sa gloire ;

il ouvrit l'art à tout le peuple farouche qui attendait dans l'ombre.

"De sombres et puissants dessins tout à coup firent voir le grandissement qu'à travers une forme d'art pouvait prendre le labeur industriel.

"En 1882 une exposition d'œuvres de Constantin Meunier, peintures et dessins (pas de sculptures encore), précisa la portée de ses initiatives.

"Fusains colorés comme des peintures, dessins enlevés en deux coups de crayon, mordantes et tumultueuses pochades. Partout on sentait la notation exacte, un souci constant des valeurs que donne le passage rapide du jour à la nuit, une attention qui ne se lassait pas pour saisir le mouvement dans son intensité et sa mobilité. Ce fut l'observation d'un esprit très moderne. Nulle trace de sensiblerie dans l'ouvrier tel qu'il le peignait, héroïque et grossier, accomplissant ses périlleuses besognes sans penser à la mort qui est au bout." (C. Lemonnier.)

Meunier donna alors d'autres toiles, "La Descente des Mineurs," "Le Pays Noir," "Le Creuset"—qu'il transposa plus tard en sculpture et qui devint l'un des bas reliefs du "Monument au Travail," dont je vous parlerai bientôt —"L'Accrochage," "Les Hiercheuses," "L'Hécatombe" que sais-je !

Il allait bientôt se donner enfin à la sculpture, mais un intermède encore devait l'en détourner momentanément.

Meunier avait été le directeur de l'école de dessin de Louvain. Toujours besoigneux, le traitement insuffisant ne lui permettant pas de vivre, il avait sollicité du gouvernement belge un subside sous forme de mission. Le gouvernement lui accordait enfin la commande d'une copie du curieux tableau d'un vieux maitre flamand, Pedro Campagna, qu'il fallait aller peindre à Séville.

L'Espagne détournait momentanément Meunier du Pays Noir. Il devait en revenir après plusieurs mois, rapportant la copie attendue—ouvrage médiocre—et des esquisses, des croquis dont il allait tirer ses "Cigarières de Séville," une toile unique dans son œuvre, conservée au Musée de Bruxelles.

Heureusement Meunier oublia bientôt l'Espagne et revint au Borinage, aux ouvriers du fer, du charbon, du verre, dont il allait enfin styliser l'allure brutale et épique.

Ses premières sculptures parurent. Après quelques années elles lui procurèrent la gloire et le commencement d'une fortune. Il n'abandonna pas cependant la peinture et le dessin. Comme l'explique Camille Lemonnier, "la toile, le papier qu'il sabrait de larges traits, étaient souvent la synthèse de l'œuvre qu'il reprenait ensuite pour le marbre ou pour le bronze."

Constantin Meunier n'était pas né pour le bonheur. A peine sorti des torturants embarras d'argent, la mort lui ravissait successivement ses deux fils, accablait une de ses filles d'un mal qui la laissa longtemps invalide. Son grand cœur pitoyable se penchait vers les humbles et, dans les scènes ou les figures qu'il traçait, leur pauvre vie était exaltée, magnifiée, transfigurée par l'expressive éloquence de la bonté et de l'émotion de son âme.

On vit paraître alors cette série de chefs-d'œuvre, "Le Débardeur d'Anvers," "L'Homme à la Tenaille," "Le Marteleur," "Le Puddleur," "La Hiercheuse," "L'Enfant Prodigue," "Le Vieux Cheval de Mine," ce groupe imposant du "Cheval à l'Abreuvoir" érigé dans un square de Bruxelles, et "La Pietà," et "Le Grisou," et tant d'autres, grands et petits, "points de repère dans l'œuvre innombrable où inlassablement Meunier prodigue la vie, la nature et le génie."

La sculpture de Meunier apparaissait au moment où les idées généreuses du socialisme contemporain ouvraient les yeux sur les souffrances des travailleurs et prêchaient la grande pitié fraternelle. C'est un art tout d'inspiration cérébrale dont le pathétique est dû à des qualités d'essence plus haute que les mérites techniques de l'exécution. Sans doute Meunier fut un sculpteur doué. Il eut le sens des volumes, des masses, des ensembles, mais ce n'est pas par la beauté superficielle du travail qu'il s'impose. Il est souvent monotone, un peu convenu dans la répétition de certaines formes, de certains morceaux qui reparaissent sans avoir retrouvé dans l'observation du modèle le rajeunissement indispensable.

On a qualifié la sculpture de Meunier de sculpture de peintre. C'est, je crois, plutôt de la sculpture d'intellectuel, et à côté des œuvres de Jef Lambeaux, par exemple, dont je vous parlais tout à l'heure la différence est frappante : Lambeaux, sans culture, sans sensibilité, magnifique ouvrier créant de la forme vide ; Meunier, réfléchi, intense, poignant, insoucieux du galbe, du charme d'un bel ouvrage bien fait, du goût qui rend précieux chaque pouce carré de la surface d'un marbre ou d'un bronze. Là la sensualité, ici une cérébralité attendrie.

Le "Monument au Travail" fut le couronnement de la carrière de Constantin Meunier. C'est aussi son œuvre la plus considérable et la plus célèbre.

Le titre a du prestige. Les littérateurs n'ont pas manqué de consacrer au "Monument au

Travail" mille commentaires enthousiastes ou ingénieux.

Tout chef-d'œuvre considérable réalisé par un homme de génie dans la maturité de son esprit contient plus de pensée, de sens et de moelle que l'artiste ne l'avait rêvé. Sa portée va au delà, et dans des domaines intellectuels que l'auteur n'avait pas prévus! Meunier, instinctivement, sans le chercher, nous a fait sentir bien des choses qu'il avait comprises, au cours de sa vie, dans la bonté noble et généreuse de son grand cœur et de son doux esprit, mais qu'il ne croyait pouvoir exprimer par de la forme et de la matière.

L'émotion de l'artiste est contagieuse: elle inspire, par une sorte de magnétisme, l'intellectualité de celui qui s'approche respectueusement de son œuvre et cherche à en pénétrer la complète signification.

Meunier mourut avant que les éléments de son "Monument" fussent assemblés. Et depuis sa mort les divers bas-reliefs et statues qui en formeront un jour l'ensemble sont demeurés épars. C'est une histoire étrange et qui vaut d'être contée.

Meunier venait d'achever le modèle du quatrième et dernier bas-relief. Il n'en vit jamais l'exécution en matière définitive; la sculpture des pierres fut réalisée après son décès.

Le "Monument" doit comporter quatre grands bas-reliefs et cinq ou six statues. Je dis cinq ou six parce que plusieurs dispositions architecturales furent étudiées pour l'assemblage des sculptures de Meunier et qu'aucune ne fut définitivement adoptée

Meunier lui-même avait tantôt englobé dans certaines statues l'ensemble et tantôt les avait exclues.

Il avait modelé bas-reliefs et statues sans projet préconçu de les réunir et de faire servir leur groupement à l'expression d'une pensée. Un ou deux bas-reliefs, deux ou trois statues existèrent avant que l'idée du "Monument au Travail" prit corps. Aussi sont-ils tous de dimensions, d'échelles différentes. Et quand Meunier créa la suite complémentaire il mit la même insoucieuse fantaisie à ne pas tenir compte des proportions des premiers morceaux. Ces circonstances n'étaient pas pour faciliter l'assemblage final.

Les éléments essentiels sont les quatre grands bas-reliefs symbolisant le travail de la Mine, de la Métallurgie, de la Moisson, et du Port, ou, si vous le préférez, les quatre Éléments, car dans ce chef-d'œuvre si moderne les conceptions primordiales et simplistes de la plus antique humanité sont manifestes. La Mine c'est la Terre; la Métallurgie, avec le rideau des flammes derrière les ouvriers du fer, c'est le Feu; la Moisson c'est l'Air; et le Port c'est l'Eau!

Les statues complémentaires représentent des travailleurs au repos, le vieillard, l'homme dans la force de l'âge, le jeune ouvrier et la mère, avec ses robustes enfants, qui est aussi la personnification évidente et traditionnelle de l'Abondance ou de la Charité.

Enfin un semeur, dont l'allure symbolise assez l'Avenir et ses promesses, devait couronner le tout de son geste éternel comme les recommencements des saisons sur la terre!

Meunier avait un moment songé à placer le groupe de la mère et de ses fils en avant, au bas des gradins portant la masse monumentale. En ce cas une autre statue d'ouvrier assis eut été incorporée dans l'arrangement.

Au moment où le gouvernement belge traita avec le maître et devint le propriétaire exclusif des sculptures du "Monument au Travail" aucun dispositif n'avait paru satisfaisant et n'avait été adopté. Le contrat portait simplement que les œuvres sculpturales composant le monument seraient réunies et exposées, selon un arrangement à trouver, dans une des salles d'un Palais des Beaux-Arts dont la construction était décidée alors et paraissait devoir être commencée incessamment.

Je dirai tout de suite qu'un vote imprévu du Législateur Belge, annulant une décision antérieure et affectant à d'autres usages des crédits précédemment réservés, fit abandonner l'idée de cette construction et que par ce fait la condition du contrat devint irréalisable; il est, et sera sans doute encore pendant bien des années, impossible de loger le "Monument au Travail" dans une salle spéciale du Palais qui devait s'appeler le Mont des Arts et qui moins que jamais maintenant paraît devoir être réalisé.

Il est assurément souhaitable que le "Monument au Travail" soit enfin érigé *en plein air*—tout le monde paraît d'accord là-dessus.

Les artistes, les hommes de lettres, les critiques d'art sont unanimes, en principe, sur ce point. Restent à trouver l'emplacement et le dispositif. Le gouvernement belge, comme c'était son devoir, s'en est préoccupé. On a préconisé l'érection du chef-d'œuvre à Bruxelles, capitale du royaume; à Anvers, principal port de mer; à Charleroi ou à Mons, centres du pays industriel; à Louvain, en souvenir de l'existence de Constantin Meunier dans cette ville, où il dirigea longtemps l'école de dessin. Il semble bien que

le choix de Bruxelles ait prévalu, que Bruxelles ait obtenu le plus grand nombre des suffrages. Mais dans Bruxelles même, ou plutôt dans l'immense agglomération bruxelloise, qui groupe plus de 600,000 habitants, les sites éligibles sont nombreux ; chacun a ses partisans. Des discussions passionnées se sont élevées. D'aucuns veulent le monument à l'entrée du Bois de la Cambre, d'autres au second rond-point de l'Avenue de Tervueren : promenades larges, élégantes, fréquentées par les oisifs et les étrangers. Elles sont un peu distantes du cœur même de Bruxelles, où des enthousiastes voudraient garder le monument, en plein centre, parmi le mouvement et la vie des affaires ! D'autres encore pensent au quartier du port, car Bruxelles, par ses canaux reliés aux fleuves et à la mer, a un quartier du port, le quartier de Bruxelles port-de-mer, qui d'ailleurs aussi touche aux usines, aux manufactures, aux fabriques des faubourgs populeux.

Le "Monument au Travail" paraît devoir parler aux foules, aux masses ouvrières ; on peut hésiter sur l'opportunité de le situer à l'écart, dans le tranquille recueillement des avenues et des verdures.

Une question plus brûlante est celle de la forme à donner au monument, du dispositif architectural à adopter.

Constantin Meunier n'avait rien décidé. Il avait d'abord songé à un arrangement en façon d'hémicycle et l'on a trouvé un croquis de lui indiquant cette conception.

Puis, à l'époque où Meunier a travaillé avec Van der Stappen à la décoration du Jardin Botanique de Bruxelles, l'idée de l'hémicycle, sous l'influence de Van der Stappen, fut abandonnée. Un architecte viennois fut consulté et fournit une autre idée.

Il est piquant de remarquer à ce propos que Van der Stappen, de son coté, s'empara de l'idée du dispositif en hémicycle pour le projet de son monument à "L'Infinie Bonté" qu'il préparait en ce moment et dont des études et fragments seuls réalisés reflètent une si forte influence de Meunier !

L'architecte viennois préconisait un cube, lourd et massif, portant un bas relief sur chacune de ses faces, une statue à chaque angle, la figure du semeur surmontant l'ensemble.

C'était, sauf respect, quelque chose comme une énorme boîte à biscuits posée sur un socle de gradins et surmontée, en guise de bouton de couvercle, de la statue du semeur.

Le gouvernement belge a essayé les deux combinaisons, des maquettes conformes aux deux conceptions ont été, à grands frais, réalisées en grandeur d'exécution.

En 1905, à l'occasion de l'exposition rétrospective de l'art belge, bien peu de temps après le décès du maître, une apothéose lui fut réservée. Dans l'enceinte de cette exposition, qui résuma tout l'effort de l'art belge pendant trois quarts de siècle, où chaque maître disparu fut rappelé par un ensemble de ses œuvres, Constantin Meunier obtint la part du lion. Plusieurs galeries lui furent exclusivement consacrées. Au centre de la plus grande, l'architecte Acker, un autre grand Belge disparu, avait édifié l'hémicycle portant les quatre bas-reliefs fameux flanqués chacun des statues accompagnatrices. En avant était posé le semeur. Un jeu sobre de degrés, de moulures, de corniches encadrait les magistrales sculptures. Toutes les différences d'échelle, de dimensions, de présentation, dont j'ai parlé, avaient été ingénieusement escamotées. L'ensemble était émouvant de grandeur de simplicité. Chacun dut, en se trouvant tout à coup devant cet éloquent chef-d'œuvre, en ressentir l'effet. Les hommes ôtaient leur chapeau, les femmes se taisaient . . . un instant. On put croire la question résolue. Mais les intérêts en jeu n'étaient point satisfaits. La solution fut paralysée par la résistance des héritiers de Meunier.

Plus récemment Louvain eut une exposition commémorative de l'œuvre de Constantin Meunier. Le gouvernement belge intervint largement dans la dépense. Une nouvelle maquette, conforme cette fois au plan de l'architecte viennois, fut édifiée dans la cour de l'un des principaux instituts, dépendant de l'université. Le chanoine Théry prodigua son dévouement, il paya de sa personne et de sa bourse, sans compter ! Il voulait fixer la forme définitive du chef-d'œuvre et espérait garder à Louvain un exemplaire conforme à la maquette. Bruxelles eût érigé l'autre dispositif, l'hémicycle ; le premier eût montré les bas-reliefs en bronze, le second les bas-reliefs en pierre : la Belgique eût été dotée des deux versions si nettement différentes du "Monument au Travail." Quelle attraction d'art, et quelle curiosité de comparaison offerte !

Hélas ! la maquette de Louvain, comme celle de Bruxelles, fut démontée sans que rien fut résolu.

Mesdames et messieurs, je dois vous avouer qu'un seul homme a parlé jusqu'ici avec une complète et entraînante éloquence de l'art de Meunier et en a mis en lumière toute la signification complexe. C'est mon ami Jules Destrée,

en ce moment retenu en Italie par une mission dont le gouvernement belge l'a chargé. Pour ceux qui l'ont entendu commenter l'œuvre de Constantin Meunier, qui ont gardé le souvenir de son verbe imagé, de sa voix persuasive, de sa pénétration généreuse, j'ai peur de paraître presque sacrilège en touchant, après lui, un sujet qu'il a fait sien.

Je ne l'eus pas traité si les circonstances ne m'avaient paru justifier mon audace.

Je fais apparaître sur l'écran le buste de Constantin Meunier par Victor Rousseau, qui appartient au Musée de Bruxelles. C'est un merveilleux résumé expressif du masque du vieux maître. Rousseau y a travaillé longtemps d'après nature dans l'atelier de Meunier sans parvenir à s'en trouver satisfait. En désespoir de cause un jour il a remporté chez lui la masse de glaise et pendant tout un temps l'a abandonnée dans un coin. Mais la pensée de ce portrait continuait à le hanter et soudain il le replaça sur une selle et se remit fiévreusement à l'ouvrage. En quelques heures il réussit à dégager enfin l'expression synthétique qui caractérise si bien Meunier et à parachever ce magistral morceau.

Puisque j'ai nommé Victor Rousseau je veux tout de suite vous dire quelques mots à son sujet. Malgré qu'il fut très jeune à la mort de Meunier et qu'à ce moment ceux qui, devant la tombe du grand disparu, se demandèrent quels seraient désormais les maîtres de notre école de sculpture, aient dû penser peut-être à des talents plus anciennement reconnus, déjà alors certes on pouvait prédire à Rousseau la magnifique carrière qu'il allait fournir.

Comme Meunier, Rousseau est un sculpteur intellectuel qui n'a jamais fait passer le souci de la forme plastique avant celui de la pensée expressive. Toute œuvre de Rousseau a une portée, un sens, elle donne à réfléchir. On est pris, retenu, intéressé avant d'admirer l'art du sculpteur, éxécutant technique cependant remarquable.

Je n'aurai pas le temps de m'appesantir beaucoup et je vais bien vite vous faire projeter quelques ouvrages de Victor Rousseau. Vous avez eu l'occasion de voir à Londres même des morceaux charmants de lui, bustes, figurines, fragments, d'une grâce fine, jeune, délicieuse. Ce n'est là qu'un côté de l'art de Rousseau. Dans des compositions très importantes, de dimensions considérables, comme les "Sœurs de l'Illusion" (Musée de Bruxelles) ou le "Groupe de la Maturité" (commandé pour une place publique), il sait allier à la perfection de la forme une rare entente de la signification morale à laquelle l'art doit atteindre.

Combien nous sommes loin, devant ces ouvrages si mûris, des figures de "baigneuses" ou de "modèles au repos" dont se contente trop souvent l'imagination un peu courte des artistes, figures très belles souvent, mais inertes, d'une plasticité équilibrée qu'aucune vie intérieure ne fait palpiter.

Voici "Le Liseur," d'une conception toute intérieure exprimant de la réflexion, l'amour de l'étude. Il semble que le front du liseur émette de la lumière!

"L'Homme penché sur le Masque de Beethoven," une œuvre pensive reflétant les prédilections musicales de Victor Rousseau. Je devine que l'artiste lui-même a dû interroger curieusement le moulage du masque de Beethoven et tenter d'y découvrir les secrets de son émouvant génie.

Le groupe de "La Danse," d'un rythme juste et balancé, que l'on peut situer à un plan bien différent de l'admirable et expressif groupe de Carpeaux. Aucune analogie. Carpeaux a traduit avec puissance une allégresse physique, une joie dionysiaque. Chez Rousseau c'est de la mesure, un geste plus cérébral que vraiment physique, une inspiration musicale.

Combien je regrette de ne pouvoir vous montrer le buste exquis de S.M. la Reine Élisabeth. Rousseau a su y enclore tout ce charme, toute cette grâce, toute cette intelligente bonté qui ont irrésistiblement conquis le cœur des Belges. L'attitude actuelle de notre souveraine admirable a achevé d'inspirer au monde entier un respect sans bornes, une indéfectible affection à l'endroit de cette frêle et si ferme héroïne! Victor Rousseau a fait du buste de la petite Princesse Marie José un morceau achevé de souple et juvénile espièglerie. Je n'ai jamais, à l'occasion de quelqu'exposition à l'étranger, montré ce morceau ravissant à une femme sans qu'aussitôt elle se soit mise à caresser, à flatter d'un geste maternel, le petit dos, la nuque délicieuse de la charmante enfant.

Victor Rousseau est aussi l'auteur d'un buste du Roi Albert. Je ne crois pas qu'il soit d'une ressemblance matérielle très exacte, mais j'y lis la transcription révélatrice de ce caractère dont l'affirmation a depuis émerveillé le monde. Comment exprimer par le travail d'un outil dans le marbre le prestige que prend une figure humaine dans des circonstances si particulièrement tragiques et qui mettent en lumière la noblesse d'un libre esprit, l'énergie d'un cœur indomptable, ce sentiment du devoir, cette

abnégation de soi-même, cette simplicité poussée jusqu'à l'héroïsme, qui ont forcé l'enthousiasme du monde civilisé ?

Mesdames et Messieurs, en cessant de vous parler de Constantin Meunier j'aurais dû chronologiquement vous nommer des artistes moins jeunes au moment de la mort du maître que Victor Rousseau, et déja en possession d'une grande et légitime renommée, Thomas Vinçotte, le Comte Jacques de Lalaing, G. De Groot, L. Mignon. . .

Vinçotte est notre grand statuaire officiel. Mais bien différent de beaucoup de statuaires officiels Vinçotte a un talent très élevé, très libre, très élégant. Il ne sacrifie jamais aux banalités conventionnelles, il demeure sincère et vrai, original dans chacune de ses conceptions. Et il cherche toujours à faire mieux, à faire nouveau, à faire plus intense et plus ressenti. Même il lui arrive de se tromper, mais il ne lui arrive jamais d'être médiocre ou indifférent, ce qui n'est pas—n'est-il pas vrai ?—en général le propre d'un statuaire officiel.

Je suis obligé d'aller un peu vite et je ne puis me donner le plaisir de commenter les œuvres principales de Vinçotte, ses groupes décoratifs, ses statues et ses "memorials," le fronton, très discuté, du nouveau Palais Royal de Bruxelles, et toute la série si admirable de ses bustes.

En voici quelques spécimens : "La Musique," bas-relief du Palais des Beaux-Art de Bruxelles, d'une eurythmie antique; ce "Groupe," du Château Royal d'Ardenne (torse Triton) ; "Le Dompteur de Chevaux," placé près du Bois de la Cambre à Bruxelles ; "Le Monument De Naeyer" ; et ces bustes, "Catilina," "Le professeur Chandelon," "Léopold II.," "Le Roi Albert."

Chez Vinçotte le portraitiste est incomparable. Il excelle à mettre en lumière les traits distinctifs du modèle ; il est révélateur du caractère et du tempérament, jusqu'à l'indiscrétion parfois.

Le Comte de Lalaing, dont j'ai eu le plaisir de vous citer, lors de ma causerie sur la peinture, les tableaux, les portraits et les grandes fresques décoratives, occupe une place très en vedette dans notre école de sculpture. Héritier d'un des plus beaux noms—et des plus anciens—de l'histoire de Belgique, ce gentilhomme s'est voué à l'art avec une passion extrême. C'est un grand laborieux ; le total de son œuvre est déjà incommensurable et il est littéralement affamé de travaux nouveaux. Sa générosité égale son désintéressement et parfois ses confrères lui ont reproché de gâter le "métier" par excès de délicatesse. Presque toujours le statuaire se contente d'une indemnité pour les frais matériels de l'exécution de ses œuvres en marbre ou en bronze, et fait don de son travail personnel.

J'ai eu le plaisir de pouvoir mettre sous les yeux du public britannique, à l'exposition d'hiver de la Royal Academy, quelques fragments de l'œuvre du Comte Jacques de Lalaing, en même temps que des ouvrages de plusieurs de nos sculpteurs, dont le vif intérêt, le niveau élevé d'art, n'a pas échappé aux connaisseurs.

Voici "Le Génie Funéraire" du Comte de Lalaing, dont la tête seule a été exposée ici. C'est une conception de très belle et hiératique allure ; "Tigre et Serpents," le prototype d'une série d'œuvres mettant en lumière les souples luttes ou les jeux des félins. (Base de mât électrique.)

Voici une œuvre de M. Guillaume De Groot, sculpteur puissant auquel on doit divers monuments et statues. ("Le Travail.") Et un groupe de feu Léon Mignon, spécialiste de la sculpture d'animaux, qui a créé les modèles d'une robuste décoration placée à Liege, sa ville natale. ("Dompteur de Taureaux.")

Je suis obligé d'aller trop vite et de citer seulement les noms des artistes, en projetant quelques aspects de leurs œuvres sur l'écran. La plupart vous sont connus, ils ont eu récemment des œuvres aux expositions anglaises, tous sont en pleine production, ils n'ont pas réalisé encore tout leur devenir, nous pouvons leur faire crédit.

Voici Jules Lagae, une façon de gothique moderne dans ses études d'humanité si parfaitement observées et réalisées—"Mère et Enfant," "Père et Mère," "Guido Gezelle," le curé poète qui a consacré à sa Flandre natale des pages si parfumées, d'un sens si frais et si sain de la nature.

Charles Samuel, dont le monument à Charles De Coster a marqué avec éclat les débuts.

Paul Dubois, robuste et harmonieux, un des coryphées de l'art wallon—"Le Penseur."

Josué Dupon, qui consacre à l'étude des animaux son beau talent décoratif "Vieux chevaux."

Fr. Huygelen, dont le Musée de Cardiff vient d'acquérir une œuvre intéressante. Voici un de ses bas-reliefs—"Les Heures."

P. Braecke, dont je n'ai malheureusement rien à vous montrer, mais dont le groupe de "Femmes de Pêcheurs," en pierre grise, fut très admiré à la Royal Academy cet hiver.

Je n'ai rien non plus de Jean Hérain, l'excellent statuaire à qui nous devons le beau bas-

relief du fronton de la nouvelle école militaire à Bruxelles, ni d'Aloys De Beule, un Gantois apprécié.

Voici Georges Minne, imagier naif comme un primitif au début de sa carrière; en possession d'un métier si souple, si expressif, si fort, un des hommes en vue de notre école à cette heure.

Fernand Khnopff, sculpteur tout à fait occasionel, mais dont aucun ouvrage n'est indifférent et qui a touché à tout avec goût et imprimé aux moindres œuvres de ses doigts la marque de son énigmatique et raffinée personnalité—"Sybille." "Jeune Femme."

Je devrais consacrer toute une étude à notre école de Médailleurs, à Godefroid De Vreese, à Paul Bonnetain, à Louis De Smeth, à Paul Wissaert et à bien d'autres. Je ne puis qu'indiquer leurs noms en passant.

Mesdames et Messieurs, vous pourrez voir la semaine prochaine à l'exposition de la Société Internationale des Sculpteurs et Peintres, Grosvenor Gallery, une série d'œuvres belges encore inédites à Londres. Nos peintures remplissent une salle, et deux des plus jeunes d'entre nos sculpteurs, MM. Rik Wouters et Marnix d'Haveloose, affirment là audacieusement leurs jeunes talents d'avant garde, leurs recherches un peu déconcertantes, un peu brutales parfois, mais dont on ne saurait dénier la valeur.

A l'exposition d'été de la Royal Academy, qui vient de s'ouvrir, l'école belge de sculpture est représentée par une œuvre maitresse d'Égide Rombaux, un marbre admirable, intitulé "Premier Matin."

M. Rombaux est, parmi nos sculpteurs qui vont atteindre bientôt leur maturité, un des plus personnels et des plus intelligents. Son art est d'un grand style, d'un rythme libre et fort et son exécution est pleine de saveur. L'apparition de ce marbre à la Royal Academy est l'occasion d'une manifestation confraternelle qui honore aussi hautement les artistes britanniques que l'art belge et dont je ne saurais assez mettre en lumière le caractère exceptionnel. Des sculpteurs, des peintres membres de l'Académy ont pris l'initiative d'ouvrir entre eux une souscription pour acquérir l'œuvre importante de Rombaux et l'offrir à la Nation. Le marbre trouvera sa place au Musée Victoria et Albert à Kensington, non loin de l'admirable série des chefs-d'œuvre de Rodin donnée par le maître.

Mesdames et messieurs, je veux voir, et les artistes belges si nombreux ici voient avec moi, dans ce geste magnifique des artistes britanniques en l'honneur d'un confrère belge, l'hommage collectif d'estime et d'admiration d'une École envers une autre École, une justice rendue par des juges dont le suffrage est sans prix. Je sais que les souscriptions affluent, malgré la rigueur des temps, dont les artistes plus que personne souffrent en ce pays, et que beaucoup s'imposent un réel sacrifice.

Il m'est impossible d'exprimer la noblesse, la dignité de cette pensee, de cette communion esthétique! Seuls des artistes pouvaient la concevoir, elle est d'une beauté morale supérieure que vous comprenez, que vous sentez, malgré la pauvreté de mon discours et l'impuissance de mon langage. Elle nous est une consolation, une revanche des outrages que nous souffrons d'autre part. Je ne pourrais mieux terminer cet entretien sur notre école de sculpture belge qu'en disant aux promoteurs et aux souscripteurs de cette manifestation exaltante la gratitude collective de tous nos artistes, notre gratitude émue et profonde, notre gratitude éternelle.

The Chairman (Lord Sanderson, G.C.B., K.C.M.G.) said that he had been presiding over a lecture and not a meeting, and that circumstance, to use a phrase of the late Lord Granville, had saved him from the compilation of some insipid remarks. But he was sure all present would wish to join with him in thanking M. Paul Lambotte for his most interesting lecture, full of instruction and not devoid of wit, and also for the very admirable series of photographs with which it had been illustrated. M. Lambotte had been working under great difficulties. In any case a collection of the kind that had been shown on the screen was not prepared without a good deal of trouble, but on the present occasion it had been much greater than usual. He happened to know that (although probably the author was not aware how he was acquainted with the fact), because he always preferred, when he took the chair on such an occasion, to learn something about the subject beforehand. He had appealed to the Director of one of our great Museums to let him see some book which would give him a slight knowledge of the works of Belgian sculptors. The Director replied that he would be delighted to show him the collection of books which M. Paul Lambotte had himself extracted from the library for the purpose of consultation, and he (Lord Sanderson) was astounded at the size of the pile. He was sure all present felt they were under a real obligation to M. Paul Lambotte for the pains he had taken to procure suitable illustrations, in addition to favouring them with the fruits of his great experience and knowledge; and he could also assure M. Lambotte that everyone present had heard with much sympathy the kind words with which the lecture concluded.

POULTRY INDUSTRY IN THE PHILIPPINES.

The consumption of eggs in the Philippines is remarkably large. There are no reliable statistics from which to compute the number of chickens annually bred in the islands, but the total is certainly very great. Throughout the country, remote from the larger port cities, chickens and eggs form a considerable portion of the diet of the people who can afford more than rice and fish. The native chickens are small, and the eggs are therefore small; but the native hen is a good layer, and the country produces a large number of eggs in proportion to the hens kept. In spite of the shortage of eggs in the country and the yearly necessity of importing millions of dozens, more attention is given to breeding cocks than to breeding hens. The fact that no Filipino of the common class regards himself equipped for living without at least one male chicken explains why the islands, although raising so many chickens, still import eggs. As in all cock fighting countries, the fighting bird in the Philippines is a personal pet, which the owner carries about during practically every idle moment of the day, and on which he lavishes a great amount of care. In recent years, according to a correspondent of the Bureau of Foreign and Domestic Commerce of the United States, attempts have been made to introduce larger breeds of chickens into the Philippine Islands, but only with moderate success. The imported breeds require much greater care and are less able to endure their environment when left to shift for themselves, as is generally the case with the native hens. Several attempts have been made recently by Europeans and Americans to breed chickens and eggs for the Manila market, but without great success. The difficulty has been that these experimenters have used imported breeds in order to have larger eggs, and the fowls have not done well, being more subject to disease than the native varieties. It is difficult to get fresh eggs in the market in any of the larger centres of population. In Manila most of the eggs on the market are imported from China. Of these from 20 to 40 per cent are unusable. So far as can be learned, there are no incubators used in the islands, certainly none on the market, except as they may be ordered direct from abroad. Chickens are usually retailed alive according to size. Ducks are bred to some extent, and a few geese. Duck eggs are rarely found in the market except as "balutes"--that is, eggs on the point of hatching, boiled, a form in which eggs are commonly eaten by the Filipinos. They are sold for lunches at all railway stations and at other points where large numbers of people assemble.

PEANUTS IN NORTHERN ARGENTINA.

The area under peanuts in Argentina increased from 33,273 acres in 1895 to 80,309 acres in 1907, but by 1912 it had decreased to 34,668 acres. The following table shows the area by provinces in the three years mentioned :—

Years	Santa Fe.	Entre Rios	Corrientes.
1895 . .	16,136	10,109	4,653
1907 .	45,714	21,498	8,649
1912 . .	21,992	5,189	1,448
Years.	**Cordoba**	**Other Provinces**	**Total.**
1895 . .	818	1,557	33,273
1907 . .	1,730	2,718	80,309
1912 .	741	2,298	34,668

The shells of Santa Fé peanuts constitute 22·82 to 30·79 per cent., and those of Entre Rios peanuts, 24·8 per cent. of the total. The principal constituents of the kernels are as follows :—

Kinds of peanuts	Water.	Protein	Fats
	Per cent.	Per cent.	Per cent.
Santa Fé . .	5·261 to 6·504	24·312 to 34·887	40 780 to 47 530
Entre Rios .	5·80	31·80	44 55

Over 5,000,000 lbs. of peanuts were exported from Argentina as far back as 1866, and considerable quantities appear to have been exported up to about ten years ago. Customs returns covering the years from 1907 to 1913 show that, except small quantities in 1908, no peanuts were exported during the period.

The principal region for peanuts is the northern part of the Province of Santa Fé, particularly the Departments of Garay and San Javier. A considerable proportion of the yield of this district is used for oil by factories situated near the producing centres. Peanut oil is also made in the Province of Entre Rios. According to a report by the United States Consul at Rosario the northern part of Santa Fé in recent years has suffered severely from heavy rainfall, which has, of course, affected the peanut crop. The present crop, which has now been harvested (during March and April), will probably be short.

Peanuts for oil are sold at an average price of ¾*d.* to 1*d.* per lb. They are also in demand for food purposes. Small nuts of inferior quality sell wholesale at about 1¼*d.* per lb. The best grade of native nut sells at 1¾*d.* per lb. wholesale.

DEMAND FOR LEATHER GOODS IN CHINA.

With the introduction of foreign ideas the Chinese are using more leather goods than ever before, and there is a constantly increasing demand for the foreign product. This is due partly to the adoption of Western dress, and partly to the increased military activity which is noticeable in every part of China. Foreign shoes are becoming more and more popular among the Chinese, and since they travel about a good deal more than formerly they are commencing to use leather trunks, suit-cases, hand-bags, and hat-boxes to a great extent. Foreign saddlery of all kinds is also enjoying a wider sale, and leather belts and straps for wrist watches are coming more and more into vogue. Not only are these articles used by the increasing military population, but leggings, cartridge cases, and other articles are enjoying a wider sale. Although the Chinese are able to imitate the leather goods from abroad, says the American Consul at Chungking, the materials which they use are, as a rule, of very inferior quality. The native leather is poorly tanned, and is generally odoriferous. It is spongy and easily affected by moisture. The wearing quality is poor, and it generally has a dull and lifeless appearance.

The Japanese have not been slow to take advantage of the demand for leather goods of foreign manufacture, but the goods which they sell have not been altogether satisfactory to the Chinese. Frequent complaints are made with regard to the quality, durability, and the appearance of their products, and the prices, while comparatively low, do not mean economy in the long run. There is a demand for almost every class of leather goods which may be purchased for personal use. Leather belting and leather goods of a similar character intended for manufacturing purposes would not, it is said, sell to any extent at present, but most of the articles named above could be sold to advantage. It is important, however, that prices be as low as possible, consistent with good workmanship and fair quality. As the *per capita* wealth in China is low, it is difficult as a rule to obtain high prices for any class of goods. The prices of foreign competitors must, therefore, be met as far as possible in order to obtain a share of the trade. Shoes should be made to sell in China for from 10*s*. 6*d*. to 12*s*. 6*d*. Pointed toes are preferred to the broad rounding toes. The demand would be chiefly for men's sizes. Both brown and black shoes enjoy a ready sale. The former, however, are generally preferred.

DECLINE OF SERICULTURE IN ITALY.

The result of an inquiry, made by the Consiglio per gli Interessi Serici, as to the causes of the decline of silkworm-rearing in Italy, has just been made public. According to this report, this decline may be attributed to four general causes, viz., (1) Emigration of the rural population and consequent increase in the cost of labour; (2) Low prices realised by sale of cocoons due to depression of the silk trade generally throughout Italy; (3) Japanese competition in the supply of raw silk in the world's markets; (4) Increasing production of artificial silk.

To these four chief causes must be added the ravages of the *diapsis pentagona*, which disease has been particularly felt in Piedmont, Lombardy, and Liguria. In the first-named region the extension of the rice fields has gradually reduced the area formerly occupied by mulberry trees. In Emilia, especially in the Provinces of Forli, Parma, Piacenza, and Ravenna, the cultivation of the vine, sugar beet, tomato and market-garden produce is gradually displacing that of the mulberry.

In Tuscany, where the destruction caused by the *diapsis* has been comparatively insignificant, vineyards and intensive culture of all kinds of vegetables are increasing. Here, as in the Marches and Umbria, the want of well-organised markets for the sale of the cocoons is felt, and in consequence the peasantry, finding but little encouragement for their labours, have nearly abandoned the cultivation of the mulberry.

Similar causes appear to exist in the neighbourhood of Rome, the Abruzzi and the Campagna, where the scarcity and the high price of labour is making itself felt. In the last-named region, the mulberry plantations are giving way to the more profitable cultivation of fruit. Diseases of the silkworm have done much to discourage the rearing of the insect.

Further south, in the Basilicata, Apulia, and Calabria, where sericulture flourished in ancient times, it is now found more profitable to cultivate the vines. In the islands of Sicily and Sardinia, the latter once the home of a very flourishing silk-producing industry, as well as for the production of "seed" (silkworms' eggs), the same conditions prevail, and the rural population find little inducement to persevere in the rearing of the silkworm.

Many reforms no doubt are needed, amongst them a more rational cultivation of the mulberry tree. Practical instruction in silkworm rearing, the choice of suitable breeds of the insect, and, above all, the establishment of well-organised markets for the sale of the cocoons when produced is especially needed in order to give an impetus to sericulture throughout the kingdom.

ARTS AND CRAFTS.

Design at the British Industries Fair.—The British Industries Fair at the Agricultural Hall has been both criticised and appreciated to a very considerable extent, but it certainly was a very interesting show, and its importance was materially enhanced by the smaller exhibitions of foreign goods organised by the Board of Trade earlier in the year. The industries

represented were not so numerous as one might perhaps have anticipated, but the exhibits in those trades which were included reached good numbers. The manufactured goods were divided into five departments—printing and stationery: cutlery, silver, electro-plate, jewellery and clocks; china, earthenware and glass; fancy goods, and, finally, toys and games. But in addition to these there was a special section devoted to designs. These were all for surface decoration, and comprised working drawings for cotton printing, tapestry, wall-paper, silk, velvet, lace, printed linen, as well as book covers and posters, and, in some cases, the actual manufactured goods. It must be admitted at the outset that the colour of these exhibits was not all that could have been desired. Very often it was decidedly dull and dumb and drab. Allowances must, however, be made for the fact that the light in which they were shown did not by any means help them. For all that, the collection left one with the impression that in the colouring of our designs we had something to learn from our rivals. With regard to the actual construction of the patterns themselves, we have far better reason to congratulate ourselves. In the various recent exhibitions we have seen that the Austrians at least have been producing simple, fresh patterns for printed linens, cottons and other fabrics, from which, though we may disapprove of some of them, we have a good deal to learn. The designs at the Agricultural Hall demonstrated that in the design of dignified and important work we are by no means behind—at present, though even here there is room for a word of warning. The best pattern design at Islington was not by young men. There were good examples of the skill of masters like Walter Crane and Lewis F. Day, who have passed away; there was excellent work which over and over again stood out from its surroundings by Mr. S. G. Mawson, as well as very workmanlike productions from many other designers, but they were men by no means in their first youth. This may be due to denseness on the part of manufacturers who have not the pluck to employ untried talent. It is probably, in some measure at least, the result of that side of the Arts and Crafts movement which has discouraged our cleverest younger men from turning their attention to design for manufacture.

The poster designs again, though they were not very numerous, made one realise that the great superiority of the Germans' work is not really in their actual designs for posters, but in their grasp of what can be cheaply and effectively done by lithography. Amongst successful designs shown may be instanced Mr. Macdonald Gill's very satisfactory underground railway advertisement and some very direct examples of Mr. George E. Kruger's drawing, as well as a clever sketch by Mr. Walter Bayes. On the whole, the exhibits, though one would like to have seen a greater number of them, formed a very creditable collection. It was in no sense showy, but it revealed the fact that a solid amount of work is being turned out which is both practical and of some real artistic merit. That may not be, and in fact is not, all that could be desired, but it is a great deal better than some croakers would have us believe.

Arts and Crafts at the British Industries Fair.—In the various other sections of the exhibition there was a good deal which was interesting from the artistic side. The pottery exhibits were on a large scale, and included ware of all kinds, and though some of the best firms were unrepresented there was plenty that was worth looking at. Among the more definitely artistic productions exhibited, Messrs. Josiah Wedgwood & Sons' painted lustre was well worth attention, both as beautiful in itself and as a comparatively new venture on the part of an old firm. The lustre effect combined with a matt surface shown by Moorcroft, of Burslem, was new and very happy, as were some of the colour effects in broken glazes obtained by the same firm and the crystalline and flambé work sent by Messrs. Doulton, of Lambeth. Some of the peasant pottery was unnecessarily rude and roughly made, suggesting a rather affected rusticity, but the art pottery of Baron, of Barnstaple, reached a level which brought it into a rather different category. It is to be regretted that there was not a better show of tiles. The industry is an important one, and was very inadequately represented.

As might have been expected, there was some very good work shown in the printing and stationery section; but after the Printing Trades Exhibition last year, which was, of course, on a larger scale and made more special appeal to a technically-educated public, there was little to call for special notice. It was interesting to see, however, that though our tin and paper boxes lagged behind the foreign productions shown at Goldsmiths' Hall in freshness of design, there was nothing to indicate any reason why, with a little care and thought, we should not produce something better still in the near future. The work of this kind was undoubtedly effective in the distance; it was only at comparatively close quarters that one realised how much better it would often have been if only it had been simpler and more direct. The cutlery and silver department and the show of fancy articles hardly claimed attention from the point of view of Art. When we turn to the toy section, however, the case is quite different. Some of the industries included under this heading were, of course, old-established and obviously slow-going; others were so new that they were quite evidently still in the experimental stage; but, taking the exhibits as a whole, there was distinct evidence of a revival

in an artistic direction. The large hand-carved wooden horses, lions, etc., shown by Messrs. Hart & Ventura, simple as they were, were artistically designed, the soft toys exhibited by the Royal Tunbridge Wells Toy Industry, the small wooden things made by the Altrincham toy industry and the cleverly-jointed dragons and other beasts from the East London toy factory, as well as some of the objects shown by the Women's Emergency Corps, all held promise of future achievement. On somewhat different lines the wooden toys exhibited by Messrs. C. Hedges & Co., and by Mr. Arthur Owen, of Sheffield, were well worth attention. Not only did the Noah's arks and the animals inside them show great improvement on the old-fashioned versions, but the wooden soldiers and forts sent by these and other firms had some quite well-founded pretensions to artistic value which were altogether lacking in most of the toys being put upon the market before the war. A few of the rather spooky toys which made their appearance early in the autumn are still to be seen, but the proportion they bear to the whole output does not appear to be very great. It really looks as though there were a reasonable chance of the toys of the future having an artistic quality—most useful in assisting the unconscious education of the child—which, in the case of those which used to be produced, was conspicuous by its absence.

The Design and Industries Association.—The inaugural meeting of the Design and Industries Association held at the Abercorn Rooms, on May 19th, was very well attended. Lord Aberconway was in the chair, and the speakers included Sir Cecil Smith, Mr. John Marshall (of Marshall & Snelgrove), Mr. Sixby (a manufacturer), Professor Lethaby, Mr. Morley Fletcher (principal of the Edinburgh School of Art), and Mr. Caterson Smith (head of Birmingham School of Art). Amongst the most practically interesting and effective speeches may be mentioned those by Mr. Symonds (representing the Board of Trade), who emphasised the fact that, in looking towards the future, we should all have to take into account that our appeal would have to be made to a public whose spending powers were decreased by the war taxation and other causes; by Mr. John Marshall, who strongly urged co-operation between all those concerned, and Mr. Morley Fletcher, who frankly stated his conversion to a belief that trade and art needed to be brought into close contact, and that our business was to accept machine production and do the best we could with it. Mr. Jackson's little speech, too, on the relation between the artist and the practical needs of lithographic printing, was admirably to the point. Many prominent artists, art workers and art masters were in the body of the room and a few manufacturers, though one could have wished that these last had put in an appearance in somewhat larger numbers.

The new association will be watched with a very keen interest by many people. Its foundation is a sign that the younger artists, whose bent is towards applied art, are at length prepared to accept the machine as an ally instead of regarding it from afar as an alien enemy. It is to be hoped that they will succeed in attaching to themselves a sufficient number of manufacturers and distributors of the right type to make the undertaking a real success. The meeting showed that some members of both these classes are anxious to co-operate, as are also some prominent business men—Sir Kenneth Anderson among them. If the Association can only make a start on thoroughly sound lines, there seems no reason why it should not have a long and prosperous career before it. Its chief difficulties will, of course, have to be faced in the near future. If it proves itself strong enough to weather them, it may be of incalculable use to artists, distributors, manufacturers and the general public.

CORRESPONDENCE.

INDIAN TRADE AND THE WAR.

With regard to Sir Charles Armstrong's recent paper on "Indian Trade and the War" much might be said on the seriousness of the rise in freights caused by the war, and on the tendency of this rise in freights to strangle the industries which provide some of the materials that are necessary for the manufacture of munitions of war—munitions on which our very existence as an Empire at this moment depends. Manganese, for instance, which is indispensable in the manufacture of steel, cannot be exported from India to America except on a special permit, for fear lest it may—in its association with steel—find its way to the enemy. Again, magnesite may or may not be contraband. The India Office has but little information on the subject; thus exporters would, on this question, be in the hands of the Collector of Customs at the port of shipment, which would prevent the pre-arrangement of any business between India and a neutral country.

If magnesite is exported in its caustic state, it is probably intended—in combination with magnesium chloride—to be mixed with some other ingredient and used for floorings, in which case it might not be considered necessary to treat it as contraband of war. In a dead-burnt condition, however, magnesite is used for the manufacture of firebricks and as a lining for basic furnaces employed in the manufacture of steel, when its export to a neutral country might be prohibited. But, as the Collector of Customs is not likely to be an expert in minerals, it is not possible to anticipate his views.

Something might also be said respecting the granting of facilities of export to the United Kingdom of all materials necessary for munitions. Sir Charles Armstrong mentioned that the Government of India has taken over the temporary control of the export of wheat. It would be of great interest to know whether the Government is likely to give increased facilities for the export of manganese and magnesite, for the trade in these minerals is being largely suppressed by the excessive freights which at present prevail. It is possible that the stock of manganese in the United Kingdom may suffice for immediate requirements. But the stock of crude and dead-burnt magnesite is notoriously low, and as the speedy and continuous output of munitions of war is a matter of life and death, a consideration of the mineral resources of India has become a question of pressing importance

C. H. B. Burlton.

OBITUARY.

Sir Charles Haukes Todd Crosthwaite, K.C.S.I.—The death of Sir Charles Crosthwaite took place on May 28th at his residence, Long Acre, Shamley Green, Surrey. He was born in Ireland in 1835, and educated at Merchant Taylors' School and St. John's College, Oxford, of which he was an honorary fellow. He then passed into the Indian Civil Service, and proceeded to the North-West Provinces. In 1877 he was transferred to the Central Provinces as Commissioner of two divisions, and afterwards he became Judicial Commissioner there and an additional member of the Viceregal Legislature. In 1883 he was sent to Burma to act for the late Sir Charles Bernard as Chief Commissioner; a year or two later he returned to the Central Provinces in the corresponding post, and two years afterwards he was made a member of the Public Service Commission.

In 1887 he returned to Burma as Chief Commissioner, a post which he held till 1890, and here he did some excellent work. He replaced the costly military garrisons by military police, and established a network of posts, by which the gangs of dacoits and other disorderly and dangerous people were broken up. Before he left the country, in 1890, it was practically settled and pacified, and for his services in this direction Sir Charles received the honour of K.C.S.I.

In 1890 he was recalled to this country to serve as Home member of the Government of India, but he went out again soon afterwards as Lieutenant-Governor of the United Provinces. Through ill-health he came back to England in 1895, and he was then called by Sir Henry Fowler to serve as member of the Secretary of State's Council, in which capacity he continued till 1905.

Sir Charles Crosthwaite joined the Royal Society of Arts in 1893. He was a member of the Indian Section Committee since 1896, and took great interest in the work of the Section. Several times he occupied the chair at its meetings, and he frequently took part in the discussions.

Jonathan James Harris.—Mr. Jonathan James Harris, of Grey Abbey, Cockermouth, died on May 22nd. He was born in 1841, and educated at a Friends' private school at Alderley Edge, Cheshire. In 1883, upon the death of his uncle, Mr. Joseph Harris, he took over his business, retaining the style of the firm as J. Harris and Sons, the well-known specialists in flax embroidery threads. In 1893, for family reasons, the firm was converted into a private liability company, Mr. Harris becoming chairman and managing director, positions which he retained to the end of his life, although for several years failing health prevented his attendance at the mills.

Apart from his business activities, Mr. Harris took a keen interest in politics, and did a great deal of work for the Liberal party in Cockermouth. He was also an archæologist, and a member of the Cumberland and Westmorland Archæological Society. He joined the Royal Society of Arts in 1900.

GENERAL NOTES.

Optical Glass.—Speaking in the House of Commons on May 19th, Sir Philip Magnus, M.P., made some suggestions—first, as to the means of increasing the immediate supply of optical glass, of which there is a serious lack, and secondly, as to the steps which might be taken to retain this branch of industry in our hands when the war is over. He suggested that the manufacturers of instruments should be brought into very close association with the makers of the glass, and he thought it might be practicable for the Board of Trade to appoint an officer who should visit the works of those engaged in the making of optical instruments, and ascertain from them what glass they particularly require, and what glass they may have in excess of their requirements. Some arrangement might be made among the makers of optical instruments, by which an exchange of optical glass might be effected so that the production of instruments might be accelerated. Further than that, the officer should be able to report at once to Messrs. Chance, of Birmingham, who have been very active in supplying the wants of the Navy and Army, and inform them, after having visited these factories, of the particular kind of glass which is urgently needed. Further, the War Office and the Admiralty should give orders only to those houses which are capable with the least delay of producing the instruments that are immediately required. With regard to the second point, he proposed that it might be made an essential condition of any Government contract for the supply of optical instruments for the Admiralty or the War Office that every part of the instruments should have been made in this country; and in conclusion he urged that

further encouragement should be given to the study of applied optics—hitherto almost a German monopoly—which is already being carried on at the Northampton Institute, Clerkenwell, the National Physical Laboratory, Teddington, and the Imperial College of Science and Technology.

A Whistler Exhibition.—An important exhibition of Whistler's works is being held at the galleries of Messrs. Colnaghi and Obachs, 144–146, New Bond Street. The display consists of pictures in oil, pastels and drawings, and should prove of exceptional interest, as it is the first exhibition to be opened since the "Memorial" of 1905. Thanks to the generosity of the collector, the proceeds are to be given to the Professional Classes War Relief Council.

Coconut Cake as Cattle Food. — From the results of the numerous feeding trials referred to in the *Bulletin* of the Imperial Institute, the following conclusions may be drawn: (1) Coconut cake forms an excellent feeding-stuff for milch cows, when fed at the rate of 4½ to 5 lbs. per head per day. It tends to produce a firm butter, and is thus especially well suited for feeding during warm weather, and to counteract the effect of feeding-stuffs which tend to give a soft butter. The results, so far as its effect on the milk yield is concerned, appear to be inconclusive, and further trials to elucidate this point are necessary. (2) The cake may be safely fed to fattening cattle at the rate of about 4 lbs. per head per day, without detriment to the animal or the quality of the meat. (3) The meal is suitable as a food for pigs, but owing to its relatively high price compared with meals usually used for pig feeding, it is doubtful whether it could be employed profitably for this purpose. (4) With regard to the feeding value of coconut meal for horses, it has been shown that it can replace an equal weight of oats in a ration without adversely affecting the animal. When all the factors are taken into account, coconut cake is cheaper than linseed or cottonseed cakes at the rates prevailing recently, and the difference in price per food unit per ton represents a considerable advantage to the farmer who uses coconut cake in preference to linseed and undecorticated cottonseed cakes.

MEETINGS FOR THE ENSUING WEEK.

Monday, June 7...Victoria Institute, Central Hall, Westminster, S.W., 4.30 p.m. Dr. T. G. Pinches, "The Old and New Versions of the Babylonian Creation and Flood Stories."

Royal Institution, Albemarle-street. W., 3 p.m. Mr. W. Ward, "Method of Presenting Character in Biography and Fiction." (Lecture II.) 5 p.m. General Monthly Meeting.

Chemical Industry, Society of (London Section), at the Chemical Society, Burlington House, W., 8 p.m. 1. Mr. J. B. Hobsbaum, "A new process for the refining of Chile Saltpetre." 2. Mr. A. Philip, "A Method of testing Mineral Lubricating Oils for use in forced lubricating systems for Steam Turbines." 3. Major Ferriz, "The Application of Adobe as a material for the construction of Buildings for the manufacturing and storing of explosives."

Tuesday, June 8...Royal Institution, Albemarle-street, W., 3 p.m. Professor J. O. Arnold, "The Evolution of Steel—Influence on Civilisation." (Lecture II.)

Zoological Society, Regent's Park, N.W., 5 p.m. 1. Mr. G. Jennison, "Notes on a nest-making Chimpanzee." 2. Mr. R. I. Pocock, "On the Feet and Glands and other External Characters of the Paradoxurine Genera *Paradoxurus*, *Arctictis*, *Arctogalidia*, and *Nandinia*." 3. Dr. A. Smith Woodward, "On the Skull of an Extinct Carnivore related to *Æluropus*, from a cavern in the Ruby Mines, Mogok, Burma." 4. Miss K. M. Parker, "The Early Development of the Heart and Anterior Vessels in Marsupials, with special reference to *Perameles*." 5. Dr. R. Broom, "On the Triassic Stegocephalians, *Brachyops*, *Bothriceps*, and *Lydekkerina*, gen. nov."

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8.30 p.m. Hon. Sir John McCall, "The Outlook for National Unity."

Wednesday, June 9...Biblical Archæology, Society of, 37, Great Russell-street, W.C., 4.30 p.m. Rev. W. T. Pilter, "The Personal Names Abram and Abraham."

Geological Society, Burlington House, W., 8 p.m. Messrs. R. H. Rastall and W. H. Wilcockson, "The Accessory Minerals of the Granitic Rocks of the English Lake District."

Japan Society, 20, Hanover-square, W., 8.30 p.m. Mr. C. J. Purnell, "William Adams and his Unpublished Log-Book."

Thursday, June 10...National Pension Fund for Nurses, at the Royal Society of Arts, John-street, Adelphi, W.C., 4.30 p.m.

Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Historical Society, 22, Russell-square, W.C., 8.30 p.m. Mr. E. Barker, "The Expansion of Germany since 1890."

Optical Society, at the Chemical Society, Burlington House, W., 8 p.m. 1. Mr. T. B. Vinycomb, "Note on the Achromatism of a pair of separated Lenses." 2. Mr. W. Salt, "Optical Accessories." 3. Mr. J. H. Sutcliffe, "Trial Frame Manipulation."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. W. Ward, "Method of Presenting Character in Biography and Fiction." (Lecture III.)

Actuaries, Institute of, Staple Inn Hall, Holborn, W.C., 5 p.m. Annual General Meeting.

Friday, June 11...Royal Institution, Albemarle-street, W., 9 p.m. Dr. H. W. Davies, "Music and Poetry."

Sanitary Institute, Guildhall, Bristol, 11 a.m. Dr. D. S. Davies, "The Co-ordination of Military and Civil Sanitary Services in War Time."

Astronomical Society, Burlington House, W., 5 p.m.

Physical Society, Imperial College of Science, South Kensington, S.W., 8 p.m.

Saturday, June 12...Royal Institution, Albemarle-street, W., 3 p.m. Professor R. S. Rait, "Mary, Queen of Scots. Lecture III.—Mary Stuart and her Son."

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All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICE.

EXAMINATIONS.

The results of the Elementary Examinations (Stage I.), held in March, were sent to the centres on the 1st inst. The results of all three stages in the March Examination have now been issued.

In the Advanced Stage 1,397 papers were worked. Of these 225 were awarded first class certificates, 683 second class, and 489 failed.

In the Intermediate Stage (in which is included Harmony and Rudiments of Music) 4,043 papers were worked. Of these 828 were awarded first class certificates, and 2,029 second class; 139 Higher, Intermediate, and Elementary certificates were awarded in Harmony and Rudiments of Music, and 1,047 failed.

In the Elementary Stage 8,080 papers were worked. 5,386 of these passed, and 2,694 failed.

In the May Examinations 16,004 papers were worked in all. These are now in the hands of the Examiners, and the results will be issued as soon as possible. The Advanced (Stage III.) results will probably be sent to the various centres about the end of June.

EMERALDS: THEIR MODE OF OCCURRENCE AND METHODS OF MINING AND EXTRACTION IN COLOMBIA.*

By Charles Olden.

With the exception of those occurring in the Republic of Colombia, there are no known deposits of emeralds in South America, notwithstanding statements to the contrary. It is quite true that Spaniards in ancient times appropriated stones from private owners in Peru, Ecuador, Bolivia, and as far north as Mexico; but, despite much searching in those countries, no emeralds have been found *in situ*. All must have come originally from Colombia, as they do to-day.

In Colombia there are several deposits. The chief is that now known as the Muzo and Cosquez Mines. There are also those known as the Somondoco Mines, and others of less importance. Most, if not all, of the emeralds in the Republic are found in the Department of Boyacá.

The Muzo and Cosquez Mines are situated 5° 30′ N. and 74° 30′ W. of Greenwich, and about ninety miles N.N.W. of Bogotá, the capital.

The Somondoco Mines are approximately thirty to thirty-five miles east of Bogotá.

Between these two deposits emeralds have been found, both as single gems and as deposits; but they have not, as yet, proved to be of first-class quality.

Historical.—The Spaniards first knew definitely that emeralds were to be had in Colombia on March 3rd, 1537, when the Boyacá Indians gave them presents of this gem as peace offerings. It is said that they also pointed out the location of certain mines, thought to have been what are now known as the Somondoco deposits. The Spaniards, however, did not find gems of such fine quality as they expected, though they continued to work the mines for years. They therefore sought for emerald occurrences in other directions also, and finally located a deposit at Muzo, within a league and a half of the ancient Indian capital of Itoco. The Spanish leader, Luiz Lanchero, established a strong military station there in 1555, changing the name to Santissima Trinidad de los Muzos, and from this position he was able to carry on military operations directed against the Muzo Indians, who were making a stubborn defence of their rights to the emerald mines. Several companies of Spanish soldiers, acting as escort to miners, were successively annihilated, and it was not until 1558 that the first systematic mining work was able to be taken in hand. For a time operations were confined to the Cosquez Mine. Here, however, the Spaniards were so seriously harassed by the warlike and powerful Muzos that, after a few years, they withdrew from Cosquez, and the precise locality of the deposits was lost, both sides having withdrawn from the seat of strife. Recently,

* Reprinted from the *Transactions* of the Institution of Mining and Metallurgy, by permission of the Council.

however, the mines have been re-located within very narrow limits, and will be reopened. They are said to have produced the finest emeralds in the country, and will doubtless give a good account of themselves again.

In 1594 the Spaniards concentrated their attention on the Muzo Mines, recruiting labour from their old enemies, the Muzo Indians. Hardships, sickness and heavy mortality among the male inhabitants of the department, due to forced labour in the mines, practically exhausted the supply of miners. Added to this, the Indian women refused to replenish the stock of males, fearing for them a similar fate, and this, together with the outbreak of a serious fire in the middle of the eighteenth century, caused the mines to be abandoned for a time. The deposits were worked subsequently at intervals by the Spaniards down to the Declaration of Independence of the Republic, when they became the inalienable property of the Government. Since 1844 the mines have been worked under lease from the Government, often in partnership with the lessee, and in recent years always in that way. Short-term leases only were granted until two years ago, when the mines were leased for a period of twenty years to an English company working in partnership with the Government.

Geographical.—Situated on a spur of the eastern Cordillera of the Andes, the Muzo emerald deposits lie in a natural valley somewhat resembling a funnel in shape. They lie from 20 to 150 metres above the valley, and the establishment stands about half-way between those extremes, the slopes on both sides being steep, almost to perpendicular in places.

Mining operations are carried on at various points simultaneously, at altitudes ranging from 3,000 ft. to 4,000 ft. above sea-level.

The approaches to the mines from the surrounding country are difficult, and transport is rendered tedious by reason of the bad state in which the roads are allowed to remain. Mules are employed for transportation of stores and supplies. The time required to reach rail-head varies from two and a half days to three days, according to the state of the roads. From rail-head to the capital is a matter of a few hours.

Climate.—From the fact that the mines lie in a natural *cul de sac*, the climatic conditions are not of the very best, though, generally speaking, Muzo is not unhealthy. It is hot and oppressive in the valley, but is not unpleasant in the neighbourhood of the mines, at the higher elevations.

Labour.—All the native workers are pure Indians, indigenous to the locality. The men are not recruited from the immediate neighbourhood, but are drawn from districts at least a day's journey away from the mines. It is considered more conducive to continuity of work to employ men from a distance, and there are other reasons for this arrangement which are obvious. As in all districts dependent upon native labour, the raw recruit has to be trained, and rates of pay are arranged accordingly. The men are, however, to a large extent familiar with the methods of working, so that little time is needed to train the miners in the special work for which they may be intended. The Indians are engaged for terms of not less than three months, and during this time they are not permitted to leave the establishment except by special permission from the management. As there is but one way into the mines it is not difficult to keep track of the men.

Excellent arrangements exist as to housing, feeding, medical attendance, baths, wash-houses, and other benefits for the comfort and well-being of the men. All are fed free, and there is no limit placed upon the rations of fresh meat, vegetables, etc., supplied.

For the accommodation of the small boys who have elected to accompany their elders to the mines, school is provided. Attendance is voluntary, and a fair number are always present from 6 a.m. to 8 a.m., and no deductions are made from the boys' wages for the time spent in school. The privilege is greatly appreciated.

The compound system, as understood in South Africa, does not exist here. The entire mining area constitutes the compound, and there are no side tracks by which the premises can be left.

Geological.—The Muzo emeralds occur in calcite veins traversing black carboniferous limestone, in which are found ammonites and other fossil remains, which fix the age of the deposit as Lower Cretaceous.

The calcite veins run through the limestone in all directions and at all angles. There is no well-defined dip or strike. In some parts of the deposits where, for special reasons, a mass of the formation has been left standing, with clean and perpendicular escarpment, the calcite veins show a more or less horizontal "lie." There is, however, no rule to go upon in describing the "behaviour" of the veins.

They vary in width from a mere streak less than 1 in. wide up to 18 to 24 in.; but these wider veins are not held in favour, as the gems are more frequently found in the small veins. The very best stones are looked for, and often encountered, in veins running below 6 in.

Emeralds are found in pockets in the calcite or as separate crystals. They are found also embedded in the formation, with or without an envelope of calcite matrix.

Associated with the gem are quartz crystals, water-white to green in colour; iron pyrites disseminated throughout the calcite and the formation, sometimes as large well-developed crystals in the form of pentagonal dodecahedra; green gypsum and Parisite—a fluocarbonate of

cerium, named after Paris, who discovered it at Muzo.

The entire formation is covered with earthy matter to a depth ranging from 6 ft. to 30 ft. or more, overgrown with jungle and forest growths. This capping completely hides all traces of the deposits, and prospecting is impossible until it is removed.

Emeralds are sometimes found side by side lying almost parallel, but not necessarily attached to each other. At times they are found completely bedded in the calcite or in the limestone formation. At other times they are attached by one end only to the matrix. A few days prior to the author's visit to the mines, two very fine prisms of emeralds were found side by side, unattached, weighing respectively over 500 and 700 carats. They were of good colour and transparency, and were of considerable value.

Usually the crystals are very much broken as they are laid bare, and are recovered in fragments. This does not imply that they were broken by the tools used to extract them from the matrix, the fractures being probably due to contortion and disturbance since the crystals were placed *in situ*.

Thickness of Deposit.—The deposit ranges in thickness from a few feet only up to 300 ft. Occasionally it is productive below water-level, but this is rare. The dividing line, or bedrock as it is termed, is usually situated above water-level. One wet deposit was being worked during the author's visit, and it was stated that there had not been a similar instance during the previous four years of occupation by that syndicate. Large veins are not considered favourable to the production of good stones.

Where the Emeralds may be found.—After centuries of experience it has been found that the emerald occurs at Muzo only in its calcite or its limestone matrix. It is not found in the overburden nor below bedrock. When the calcite veins reach the dividing line they are cut off absolutely and abruptly. They do not extend down to the next following stratum. Work ceases at the moment bedrock is reached, and no further prospecting is attempted below the line.

A statement often made, and sometimes seen in print, with regard to emeralds needs correcting. It is said that the emerald, when first exposed to the atmosphere, decrepitates, and that it is so fragile that it may be crushed readily between the finger and thumb. There was no evidence at Muzo to confirm this statement. The gem is found very frequently much broken while still lying within the matrix, and in process of handling it falls into its own fragments, especially when not cemented by a thin coating of calcite. The decrepitation of the crystal occurred probably centuries before it was brought into contact with the atmosphere.

The emerald is confined to its proper environment at Muzo. It is not found in alluvium, as in the case of gold, tin or other minerals. This is not to say that there is no possibility of finding the gem in the river sands in the district; indeed, there is a likelihood that it might be so encountered.

The methods which have obtained for so many years render it most probable that emeralds have found their way into the rivers flowing through the districts where the deposits are situated; but in this event they would be of comparatively recent deposition, and not a product of ancient, natural denudation of the rock. Further, the possibility of washing out the gem from the river-beds is guarded against by the absolute negation of any and every application to undertake this kind of prospecting. It may be stated, with very little fear of contradiction, that the Muzo emerald is found only in its natural matrix there, either in the calcite veins or in the formation enclosing those veins, viz., the carboniferous limestone.

Methods of Working the Deposits.—Having stripped the overburden for as large an area as is thought necessary, say, 150 ft. × 50 ft., where it is intended to continue the work on a productive bank, or, in the case of an entirely new and untried section of ground, of an area probably twice as large, some preliminary examination of the newly-cleaned outcrop is undertaken.

The author has been informed by high officials on the spot, and by experienced managers of mines within the limits of the Colombian emerald deposits, that it is quite possible for an experienced man to tell which part of a formation is likely to prove productive by the "feel" of the limestone when walking over it. Where a gritty, scraping effect is experienced on "scuffing," or scraping one's nailed boots, over a portion of the cleaned outcrop, emerald-bearing veins are likely to be encountered. Where the "feel" is smooth and free from the gritty, scratching sensation, the formation is not likely to prove productive. At any rate, this preliminary walk-over is practised, and, according to the man's personal belief in the theory, his subsequent actions are regulated.

There is always a great amount of dead work to be done before the emerald-bearing veins are uncovered, and the usual procedure is to cut into the formation, step-wise, benches or terraces, one row succeeding another as soon as the course is clear. The benches are 30 ins. deep, and the full complement of men on a bank may reach as many as 150 or more, labour being drafted to the spot as soon as there is accommodation for fresh relays. Some idea may be formed of the immense amount of dead work which may be required to be done when the bank happens to be from 50 ft. to over 100 ft. high. Every ton of hard formation has to be

broken down by manual labour, while at the same time the greatest care is needed to see that no gems enclosed in the matrix are thrown away with the waste.

How the Waste is disposed of. — The *débris* falls down the bank and collects at its foot. It is removed in the manner now to be described.*

Situated as high as possible above any new work which may have to be undertaken, there have been built three large tanks, or reservoirs, of masonry, which collect and store surface water conducted to them by ditches suitably arranged. From these tanks conduits are provided which lead to the foot of any bank upon which work is being done. The conduits are further arranged so that the tanks may discharge into them separately or simultaneously. From the foot of the banks the conduits are carried on until a convenient outlet is found into which the contents may be carried. When a heap of waste rock has accumulated to inconvenient proportions at the foot of the bank, a signal is given to the men in charge of one or more of the tanks, and their contents are emptied into the conduits and led to the desired spot, when the accumulated waste is swept away. In dry weather it may require from ten to twelve hours to fill up the tanks, though fifteen minutes only may be sufficient to discharge them, and it will be seen that the work at the banks is likely to be greatly retarded for want of flushing water. In the wet season the time required for filling the tanks is much reduced, and the work on the banks greatly facilitated.

It is obvious that the conduits should be set at a considerable declivity to ensure a sufficient force of water to sweep away the accumulated waste in its path.

The flushing method of getting rid of the waste has the very serious drawback of the possible washing away of pieces of formation containing calcite veins with embedded emeralds, or emeralds attached to the formation, which are more difficult to detect. Every care is exercised by the overseers on the banks to see that no matrix is thrown away which is likely to contain gems; but accidents may, and do, occur, causing losses, which will continue so long as the flushing method is in vogue.

Natives, under supervision, were employed to walk along the conduits below the banks to search for emeralds. At the time of the author's visit this work was attended with marked success; the eight men so employed more than earned their pay by the stones recovered. Such "free" emeralds may, and probably do, find their way into the sand of the river-beds, giving rise to the assertion sometimes made that emeralds are alluvial in origin. The risk of loss is fully appreciated by the management, but until the method of getting rid of the waste is altered, or at least modified, the risk will always remain.

A bank may prove absolutely valueless after months of work upon it. Despite the greatest care in the selection of the locality for starting the work, no one can estimate the probable value of any particular section of a deposit. In this respect emerald-mining differs from most of the other branches of the industry. The lack of conformity exhibited by the calcite veins as to dip, strike or continuity in any one direction deprive the engineer of all ordinary data upon which he could depend in forming a judgment, and the usual element of chance is much increased when dealing with the elusive emerald. There is little risk, however, in cutting down a bank immediately adjacent to a productive mine, as the veins can be followed into the new ground with reasonable prospects of success. Wherever the veins show they are followed, even if this entails cutting down a bank 100 ft. high. Once a productive formation is found it is never left until it is worked out, and this may prove to be the work of years, as frequently happens at Muzo.

Tools used in the Work on the Banks.—The tools used are steel bars about 5 ft. long and weighing 30 lb., and shovels. The bars are forged to a point at one end and made wedge-shaped at the other. In the hands of an experienced Indian the steel bar proves very efficient in breaking down the formation. It has been estimated that each skilled miner can break down, in a ten hours' shift, 15 ft. × 2½ ft. × 2½ ft., or 93·75 cubic ft., of hard formation, using the bar alone. Explosives are used when necessary, and holes are "jumped" with the same tool, and charged with blasting-powder made on the spot.

As the bank deepens and approaches the calcite veins, great care is exercised to prevent undue force being used in wielding the bar, owing to the risk of breaking the emeralds which may be in the immediate vicinity. In this careful work the Indians excel, and they can strike repeatedly the same spot in the formation with the pointed end of the bar without deviating one hair's breadth, using just sufficient force to break the limestone without smashing the calcite or the gems which it may contain. An unskilled miner, native or white, could do immense damage when using the bar in the neighbourhood of an emerald-bearing vein.

The pieces of vein liberated, together with the adjacent formation, are carefully examined for emeralds, and are set aside for conveyance to the sorting sheds, where, with proper tools and suitable surroundings, a more critical examination is made.

Emeralds showing in position in the matrix, before detachment, are removed by a "pricker,"

* The methods described here were those in vogue during the tenure of the late syndicate. It is probable that the present company have introduced many improvements.

a tool capable of loosening the gem from its bed or scraping it out of any small cavity in which it may be lying. Great care is exercised in this operation.

At regular intervals, or as often as there is a sufficient accumulation of possible matrix sorted out on the bank, it is conveyed to the sorting sheds to be dealt with in due course.

Cleaning up when Bedrock is reached.—Mining work continues on the banks until bedrock is reached. The last stage here is the careful examination of the "floor" for detached emeralds, and everything is scraped up, swept and washed to ensure that no gems are left behind. The sweepings are collected and carried to washing tables set at a slight angle, over which a steady, well-regulated stream of water is allowed to flow evenly. Here a number of small boys are engaged washing the dirty sweepings and general clean-up from the banks, rejecting the waste and picking out any emeralds which may show. They collect the gems in small pieces of coconut shell and hand them to the overseer, who, it is unnecessary to state, never leaves his place overlooking the tables.

Constant Vigilance exercised.—A bank is never left, day or night, so long as it is productive. Relays of miners are drafted to it to take the place of those who retire to meals, which are served only in the dining-rooms and never at the banks. Other relays of miners are drafted as necessity demands. When a bank becomes more than ordinarily productive, as when a rich pocket is discovered, the number of overseers is augmented and extra vigilance is exercised to prevent theft or carelessness in handling the matrix, and to see that no formation likely to carry gems is thrown over the dump. In this way work continues till dusk, when the banks are put in charge of military police or soldiers, of whom a large force is always stationed on the mines and in the city of Muzo.

Method of Working a Wet Mine.—In working a wet mine the procedure is much the same as with a dry mine, except that the work assumes the form of a trench wide enough to embrace the particular veins which are continuing productive. Greater care is necessary in dealing with the waste and in handling the valuable matrix, owing to the more restricted area of operation and to the greater facility which exists for the misappropriation of the gems. The appearance of the bottom of the trench resembles a miniature coal-mine. Everything is black, and, as a consequence of the mixing of the water with the fines from the carboniferous limestone, well-trodden by the miners, it becomes increasingly difficult to recover all the gems set free. Occasionally they are buried in the black mud, the natural unevenness of the floor increasing the danger of treading-in the crystals.

All waste is carried from the trench in hide bags, and is washed on the tables previously referred to. Loose gems are recovered, the waste thrown away, and the calcite and limestone, suspected of carrying gems, set aside for conveyance to the sorting sheds.

Instances of theft are generally detected, but it is questionable if misappropriation will ever be stamped out completely. Every care is taken in the trenches and elsewhere to minimise it, principally by making the lot of the miners as comfortable and pleasant as possible, thus removing the necessity for pilfering. This procedure on the part of the management has had a decidedly good effect on the men, and theft is much less prevalent than formerly.

In the trenches the same rule obtains as to drafting in relays of miners, and the work is never left until dusk. The water is then allowed to accumulate and to submerge the workings, and remains until the following morning. This procedure renders it difficult, if not impossible, for "poaching" to take place during the night.

According to the quantity of water which has collected in the trench, miners are detailed to pump it out. This is done by means of bamboo pumps of the usual native type. Pumping begins at 3 a.m. and is completed by 6 a.m., when the day's work begins. From two to six men are required to man each pump, depending upon the diameter of the tube and the depth from which the water has to be lifted. Should this be greater than 15 ft. or 16 ft., it is pumped in series.

When bedrock is reached the mine is abandoned, as has already been mentioned, and work commences on the formation immediately adjacent to that just worked out. The same calcite veins are exposed, and, if persistent enough to live through the new bank, are followed into the next adjacent formation, and so on.

The Spaniards worked parts of these mines by tunnels. There are serious objections to this mode of mining, principally the great difficulty experienced in following the small veins in their remarkably circuitous meanderings. After much consideration and centuries of experience, it has been found that open cutting presents many advantages over tunnelling. All operations are carried on in daylight —a matter of the greatest importance when the value of a one-carat stone of first-class quality is considered.

The Treatment of the Emerald-bearing Matrix.—Upon arrival at the sorting-sheds of the establishment, the valuable matrix is dealt with as follows: The larger pieces are broken up by light hammers and the resulting product is again reduced in size. Each piece is examined very closely for gems or emerald colourations and the waste sorted out. The final product is reserved and is again broken by light tools.

The emeralds which have become loosened are picked out, and if clean are placed into stock, while those gems to which matrix still adheres are placed in a bath of cold dilute hydrochloric acid until they are cleaned.

The Grading of the Emeralds.—The emeralds are sorted into a variety of grades, some fifteen in all, according to colour, transparency, size, freedom from fissures or enclosed impurities, and various other considerations, and are then ready for the market.

The Inexhaustibility of the Deposits.—The topography of the deposits, as seen to-day, with its evidences of alteration in contour and general features, lends truth to the legend that the mines have been worked for one thousand years or more. It would seem to be impossible in less time so to have altered the surface of the locality as to have produced its present appearance. The topographical changes now taking place are probably an exact reproduction of what has been going on for the last ten centuries, and the very primitive methods of mining and quarrying in vogue are undoubtedly those handed down by the ancestors of the present-day Indian workers. There is no evidence whatever that the deposits are likely to become exhausted for the next few hundred years.

It is not likely, moreover, that they will be worked to exhaustion in the shortest possible space of time, as the rate of extraction of the precious stone must always be dependent upon the ability of the market to absorb the gems at profitable rates.

In the cutting of a watercourse 8,000 m. long, for the most part through carboniferous limestone, no less than twenty-eight new areas containing calcite-bearing formation were intersected, extending throughout the ditch line, and these new finds will not be exhausted in a day. No stronger evidence of the presence of the emerald than is seen in these exposures was needed by the earliest workers when commencing operations on what subsequently proved to be productive banks, and there is no reason to suppose that these, when attacked in their turn, will give anything but a good account of themselves.

The cutting of ledges, whether for roads or watercourses, along the slopes of hills, in known emerald-bearing districts, constitutes a ready and effective method of prospecting, and it is not at all unlikely that the making of roads by the early Indians led them to discover the green stone which became an object of value, and, subsequently, one of the main causes which led to their own undoing.

BENGAL INDUSTRIES.

A report by Mr. J. A. L. Swan, I.C.S., on his inquiry regarding the industrial development of Bengal, has recently been issued. It is in two parts. Part I. deals in a general way with the present position, the possibilities of the future, and the measures which Government might adopt to encourage the growth of indigenous industries. Part II. consists of notes on the various industries which he has examined. Part I. is as follows :—

Some Existing Industries.

When Mr. Collin made a survey of the industries of Bengal in 1889, he found no joint-stock enterprises working with Indian capital and under Indian management. In 1907–08, when Mr. Cumming and Mr. Gupta made similar inquiries, the Swadeshi movement was at its height, and had roused considerable enthusiasm among the middle classes, who saw in industrial development a new field of employment and less severe competition than in the professions. Companies for the manufacture of pencils, matches and soap, for cotton-weaving, hosiery and tanning were floated. The big capitalists were not generally attracted by these schemes, but considerable sums were subscribed from the savings of the middle classes. Bengali directors were appointed, and in almost every case the management was entrusted to a Bengali. If these enterprises had met with a reasonable measure of success, the industrial development of Bengal would have progressed much more rapidly than it has done, or is likely to do. Unfortunately, from various causes, none of these concerns has so far achieved any success. The majority have ceased to work, but one or two are still struggling for existence. I have examined the history of these concerns, and have discussed the matter with many gentlemen who were actively interested in them.

Why Swadeshi Failed.

Difficulties in obtaining raw material, want of skilled labour, and the lack of banking facilities contributed in some cases to their failure; but the two most important causes were: (1) insufficient capital, and (2) inefficient management.

The promoters of these companies, handicapped by want of experience, failed to appreciate the danger of starting a business with insufficient capital. In almost every case the paid-up capital fell far short of the nominal capital, yet a beginning was made in the hope that money would be more freely subscribed when it was seen that work had actually started. One company, for example, was floated with a capital of Rs. 5,00,000. Of this Rs. 85,000 was subscribed, and only Rs. 65,000 was paid up. Nevertheless, plant was purchased and work commenced. It was at once found necessary to borrow money at a high rate of interest. In the circumstances, it was impossible for the company to make any profit, and naturally no more shares were taken up

by the public. The enterprise was thus hampered from the outset, and has never been able to free itself from the incubus of the debt. Another company was floated with a capital of Rs. 2,00,000, of which about Rs. 91,000 was paid up. Plant was purchased and work started; but it was soon found that the amount available as working capital was wholly insufficient to buy the raw material required to keep the machinery at work.

Want of Capital.

Adequate capital is particularly necessary in the case of industries run by Indian capital and under Indian management, owing to the reluctance of banks and of firms that supply machinery and raw materials to give them credit. When a concern has to pay cash for its raw materials, and at the same time to allow credit to its customers, it must have at its command much more working capital than a similar business which enjoys the usual banking facilities. The absence of these facilities has been mentioned to me as a serious difficulty by almost all the managers of Indian manufacturing concerns.

There are at present no signs that Indian capital is likely in the near future to be freely invested in industrial enterprises. Wealth is not diffused over a great middle class as in England. Apart from the Marwaris, it is mostly in the hands of landowners and a few professional men who prefer to invest their surplus in land or to lend it out. Money lent on mortgage will yield 6 per cent. with absolute security. If the capitalist is willing to take risks, he can get very much more than this. In these circumstances, he is naturally reluctant to invest money in industrial enterprises, the success of which is problematical, and which, at the best, are not likely to yield much more than the 6 per cent. obtainable without risk. His reluctance is enhanced by the discouraging history of these companies. Until it has been demonstrated by individual enterprise or otherwise that new industries can be developed with some assurance of profit, the capital of Bengal is not likely to flow into industrial channels.

Inefficient Management.

It is not a matter for surprise that inefficient management should have largely contributed to the failure of the Swadeshi companies. From the character of the movement, it was natural that they should be started, not only with Bengali capital, but also under Bengali management. There were, however, few men in Bengal who were fitted by training to be directors or managers of industrial concerns. The directors were chiefly selected from the professional classes. Many of them were men of great abilities and eminent in their own professions; but they had had no opportunity of gaining experience in business methods and finance. In industrial countries, the board of directors of a company includes men with an intimate knowledge of its particular business. Such men were not available in Bengal. Consequently the directors of these companies were hampered by the lack of expert knowledge and advice. This led in some cases to serious results. For instance, one company purchased plant which was afterwards found to be useless and which had to be discarded.

It was equally difficult to find men competent to manage those concerns. The field of choice was practically limited to those young men who had been sent in the past few years to Europe, America and Japan for industrial training. Many of them had returned with excellent certificates and a high degree of technical knowledge; but they had had no training in the business side of a manager's duties. Their qualifications would have made them most valuable assistants, and after some years' experience they would probably have been competent to undertake the duties of management; but with no training in how to buy and sell to the best advantage, or how to finance a business, they were not then qualified to organise and manage new industries, and it is not surprising that in most cases they failed.

Some Successes.

While the experiences of these joint-stock companies have been depressing, other more hopeful developments have taken place. There are now a number of industrial concerns, founded by individuals or small syndicates, which are working at a profit, or which have made sufficient progress in the experimental stage to justify confidence in their success. A private individual who enters on such an enterprise generally does so because he has a natural inclination for the business and probably some practical knowledge of it. He knows exactly how much capital is at his command, and he cuts his coat according to his cloth. The shareholders of the limited companies expected an industry to spring fully equipped from the promoters' brain. These practical men, realising that they and their workmen must buy experience, have been content to start on a small scale, and to extend slowly as they felt their way. The earliest enterprise of the kind was the Bengal Chemical and Pharmaceutical Works, which, founded in 1892 by a small syndicate, is now a limited company with a paid-up capital of Rs. 3,50,000 and pays a steady dividend. Messrs. F. N. Gooptu and Co., starting on an experimental scale in 1905, have now a large and well-equipped factory for the manufacture of penholders, nibs and pencils, and hold large contracts from the Controller of Stationery. Messrs. P. N. Dutt and Co., of the Bengal Galvanising Works, turned out five dozen

galvanised buckets a day when they started in 1908. The plant has been gradually improved and extended, and the outturn is now 150 dozen a day. The Calcutta Pottery Works have a thoroughly up-to-date plant, including machines for the manufacture of electrical porcelain fittings. Several small hosiery factories are working successfully, and the Bengal National Tannery is now in a hopeful position. If the success of these and other private ventures is set off against the failure of the joint-stock enterprises, it may fairly be claimed that the last few years have been a period of distinct, if slow, progress in the industrial development of Bengal.

Effects of the War.

When the European war broke out, it appeared that an opportunity had presented itself for a more rapid development of the industries of Bengal. In some cases raw materials are exported from this Province and are manufactured in Europe, and in other cases articles are imported from Europe, though the raw materials are available here. Hides, for example, were exported in enormous quantities to Germany, where they were tanned. Chemicals to a very great value are annually imported from Europe, though there is abundance of raw material for the manufacture of many of them here. It seemed certain that if such articles as chemicals, leather, glassware, matches and pencils were produced locally, they would find a ready market at a profitable price.

But though the war presented opportunities, it also created difficulties. The capitalist, affected by the prevalent feeling of uneasiness and uncertainty, became nervous and anxious to keep the control of his money in his own hands. The effect of the situation on existing industries was not encouraging. The jute trade was, for the first three months at least, in a state of stagnation. The *raiyat* who could not sell his jute was unable to make purchases, and the textile industries lost their great market in Eastern Bengal. One gentleman, who owns a silk factory, told me that at the time of the "pujas," when he generally sells most of his annual outturn, his sales this year were one-thirtieth of the average. Many industries were seriously affected by the cessation of imports of aniline dyes, chemicals and bottles from belligerent countries. Advantage of the situation was taken by some existing firms to develop new lines of business, but no new productive industry has as yet been started.

While the industrial development of the Province must depend on private enterprise, I think that the encouragement of Government might take a more active form than it has hitherto done. One demonstration is more convincing than a dozen monographs. Anyone who has decided to start an industry will find much valuable information and advice in the monographs published by Government, but no one is likely to be persuaded by merely reading a monograph to start an industry. If, on the other hand, Government can demonstrate that an article can be manufactured at a certain cost, that a market can be found at a certain price, and that the margin of profit is reasonable, the opportunity will not be long neglected.

In his despatch of July 29th, 1910, to the Government of India, the Secretary of State expressed his disapproval of "pioneer industries" conducted by Government on a commercial scale, likely to interfere with private enterprise. He considered, however, that there was no objection to the establishment of a bureau of industrial information or to the dissemination of intelligence and advice regarding new industries, processes or appliances. To be of any real value, such information and advice must be based on actual experiments, such as are now being, or are about to be, undertaken in Madras.

The Example of Madras.

The Director of Industries, Madras, is in an advantageous position for making these experiments. He is at the head of an organised department which has been in existence for some fourteen years, and has a large expert staff. He is assisted by an Inspector of Industrial Schools, an officer in charge of pumping and boring operations, a dyeing expert, a leather expert, and a personal assistant, who is an experienced mechanical engineer. The subordinate staff consists of twelve supervisors, twenty-four mechanics, and sixty *mistris*. His annual expenditure amounts to almost three lakhs of rupees, of which about half is absorbed by technical education. Since the war broke out he has been given considerable grants for the purpose of practical experiments, which will include ground-nut-pressing, soap-making, glass-making, and the manufacture of paper-pulp, matches and pencils. The experiments in ground-nut-pressing have been in progress for some time with a small plant worked by an oil-engine. The results have led Government to make a large grant for experiments on an extended scale. These will not compete with private enterprise, as a local firm supplies the raw material, and the oil and oil-cakes produced are returned to them. This firm keeps accounts of the cost of the ground-nuts and of the price obtained for the oil and oil-cakes, while the Director keeps an account of the cost of pressing. In this way he is able to arrive at an accurate estimate of the commercial possibilities of the business. As a subsidiary industry, he proposes to experiment in the manufacture of soap with ground-nut oil.

Some time ago a glass factory was erected in Madras, and was equipped with automatic blowing-machines for making soda-water bottles.

This enterprise failed for causes which, the Director thinks, might have been avoided. The proprietor has placed the buildings and machinery, with the stock of raw materials, at the disposal of the Director. Some alterations are being made in the furnaces, and the machinery is being brought into working order. When this is done, the Director proposes to start the manufacture of soda-water bottles and bangles on an experimental scale. If he is successful, the proprietor, it is hoped, will take up the business again. A pencil-making plant, which was imported at the time of the Swadeshi movement, and a paper-pulp factory have also been lent to the Director by the owners, who had failed to worked them profitably.

Those experiments have not yet reached a stage at which practical results can be expected. The Director can, however, point in the past to his successful work in the field of chrome-leather tanning and the manufacture of aluminium ware. The Madras Aluminium Works have proved a highly profitable enterprise, and the Mysore Tannery, which was established under Mr. Chatterton's auspices, also pays a dividend. The success of the Director's efforts to extend the rice-hulling industry in Madras has been so unexpectedly great that he now fears the effects of too keen competition. I think that these examples are sufficient to justify the hope that similar experiments in other parts of India will lead to practical results. The most suitable industries for such experiments are, in my opinion, those which have already been tried, and have failed for causes which might have been avoided. The officer-in-charge of the work will have these causes before him, and will know exactly what difficulties he must try to overcome. He will also probably be able to obtain the use of existing plant, and so reduce the cost of the experiments. In Bengal, for instance, the manufacture of glassware and matches has been attempted and has failed. The attempts at glass-making were reviewed by Mr. Wagle, the glass expert, in his report written in 1906, and he attributed their failure to preventible causes. It would, I think, be possible to arrange with the proprietor of the glass factory at Sodepur for experiments in glass-making, unless, in the meantime, these are carried out by a European firm which is interesting itself in the matter. I have found two match factories, of which one has ceased to work, and the other is likely to do so in the near future. The failure in both cases is directly due to want of capital. What the result would have been if these concerns had had sufficient capital it is impossible to say. There are one or two other difficulties to be overcome, such as the question of a suitable wood. The *genwa* wood from the Sundarbans, which was used in both factories, was not altogether suitable, as it did not split evenly. I think that this is an industry in which practical experiments, made with the co-operation of the Forest Department, would be of great value.

Government Patronage Needed.

Government patronage might be extended more freely than at present to articles of local manufacture. A partner in a large engineering firm complained to me that they do not get a chance of tendering before indents are sent to the Director-General of Stores. When they get an order it is for a small quantity required to meet an unforeseen demand, or because the amount indented for has proved insufficient. For a small quantity a higher price must be charged than for a large order. This, however, is taken as their fixed price for an article. He gave me a concrete case in which they got a small order for rivets from a Government department, and had to charge Rs. 9 a hundred. When they asked for further orders, they were told that the imported rivets only cost Rs. 7–12 a hundred. On making enquiries, they found that the annual requirements were very large, and that if they got the whole order they could profitably supply them at this price. They represented the position to the officer-in-charge of the department and have now got the order. In another case, I found that certain articles of local manufacture had been brought to the notice of the head of a department by Mr. Cumming in 1908. When the factory asked for an order they received the reply: "Should occasion arise for the purchase of these articles locally, your letter will then be considered." When I brought the position to the notice of the present head of the department personally, he was keenly interested, and will give the factory his orders if his requirements can be met. The fullest opportunity of tendering should be given to local firms before indents are sent to the India Office.

Some Suggestions.

In dealing with particular industries in the second part of this report, I have made some suggestions which may be briefly summarised here :—

1. Co-operative credit societies should be established among cottage-workers, such as cotton-weavers, silk-weavers and brass-workers. The officer-in-charge of these societies should assist in the purchase of raw material and in finding markets for the finished article.

2. Demonstrations in the use of improved processes and appliances should be given at suitable centres. Much has already been done in this direction for cotton-weavers. But demonstrations might also be given in such matters as the use of the flyshuttle for *tussar* and silk-weaving, and the use of an improved lathe and a die-stamping machine for brass-work.

3. The Forest Department should make

special arrangements for the supply of suitable wood, on favourable terms, to such industries as matches, pen and pencil-making.

If such measures as these are taken, the Government, I think, will have gone as far as they can go to encourage the industrial development of the province. The rest must depend on private enterprise, and, for the present, on individual efforts rather than on joint-stock companies. The industrial development of England was already far advanced before the day of joint-stock companies arrived, and, even now, the great manufacturing companies are almost all the outcome of private enterprises which were started on a small scale, and were established successes before the public was asked to subscribe its money. In Bengal, too, individuals must create confidence in their commercial ability and integrity by their success. When they have done so, the capitalist, or the middle-class man with savings, will not be slow to avail himself of a new field of investment.

THE MANUFACTURE OF GASOLINE (PETROL) FROM NATURAL GAS IN THE OIL-FIELDS OF OKLAHOMA.

By Chas. N. Gould.

During the past few years a new industry has been established in the oil-fields of North America, particularly in the Ohio-Pennsylvania fields in the eastern part of the United States, and the Mid-Continent fields of Kansas and Oklahoma. This industry consists of utilisation of a product which has heretofore gone to waste—namely, the so-called "casing-head gas" from the oil wells—in the manufacture of gasoline.

Chemists have long recognised the fact that petroleum and natural gas are but two manifestations of the same series of complex hydrocarbons, petroleum being the liquid form and natural gas the gaseous form. If petroleum is distilled in the retort in the chemist's laboratory, or in the still in the refinery, heat is employed to drive off the lighter and more volatile substances. The first products are given off in the form of gas, which, being condensed, forms various light oils, the most important of which are naphtha, benzine, gasoline (petrol), and kerosene.

It has been found that wells from which oil has been taken for a number of years often yield gasoline in the gaseous form; that is to say, the natural gas given off from these oil wells can be condensed to form gasoline.

Natural gas may be divided into two classes: (1) So-called "dry gas," known and used as a natural gas of commerce, which usually comes from wells containing little or no petroleum; and (2), a gas containing easily liquefiable vapour known as "wet gas," which comes from wells yielding petroleum. The latter product is often known as "casing-head gas," because of the fact that it is most frequently obtained from between the casings or pipe in the oil wells.

As early as 1904 the liquefaction of natural gas products by compression was undertaken in the oil-fields of Pennsylvania and other States in the eastern part of North America. Within the past few years this industry has assumed considerable proportions in the mid-Continent fields of Kansas and Oklahoma. In the year 1914 there were more than sixty separate gasoline plants in Oklahoma engaged in the extraction of gasoline from "casing-head gas." The average amount of gasoline obtained varies from one gallon to seven gallons of the liquid product to each 1,000 cubic feet of gas, the average being, perhaps, three and a half to four gallons per thousand feet. The price paid for the gasoline at the various plants in Oklahoma varies from 5 to 7 cents per gallon.

It has been found by experience that the gasoline obtained by compression is of unusual strength, and at the same time it is extremely volatile and evaporates rapidly, so that in order to utilise the product it is often necessary to blend it with certain other light oils, naphtha being the one usually employed. Gasoline of the gravity of 87 per cent. to 95 per cent. Baumé is mixed with naphtha with a gravity of 50 per cent. Baumé, so that the gravity is reduced to 65 per cent. to 70 per cent. This process renders the liquid more easily handled and produces a high quality motor spirit.

The method of manufacture of natural gas is briefly described in Technical Paper No. 10 of the United States Bureau of Mines as follows:—

"Up to the last two years the general practice in the manufacture of liquid natural gas was to make the product by compression of the gas in single-stage compressors, operated at a pressure of 150 to 300 pounds per square inch. The one product thus obtained, so-called 'natural gasoline,' was run into a tank and 'weathered.' The weathering consisted in allowing the lighter portions to volatilise spontaneously and escape into the open air until such time as the boiling away of the liquid had practically ceased. Thus the process involved a loss of 25 to 50 per cent., or even more. This loss was an absolute waste, not only of power and of cost of operating the engines and compressors, but of the product itself.

"The next step in the industry was to pass the waste gases (of which only the small quantity used for power had been utilised) from the single-stage compressor through a higher stage compressor, thereby getting a second and more volatile product—a 'wilder' liquid—which was run back into the first tank and mixed with the first or heavier condensate. This mixture was then again weathered to a safe degree, whereby it lost the greater part of the more volatile product that had been condensed in the second stage.

"Recently the process has been improved another step, in that the first stage compressor product is run into one tank and handled as ordinary gasoline; the second-stage compressor product is run into a second tank and handled as a lighter gasoline, with which the heavy refinery naphthas can be enriched or enlivened.

"The last-mentioned method of using the second-stage compressor product should receive wide recognition, and a market for the product should develop that would be no mean factor in the industry. Blending in the proportions of, say, one part of the product to four or five parts of the refinery naphthas makes these heavy naphthas more volatile and of greater value as fuel for automobiles; it also greatly increases their general usefulness. The proportions to be used in blending, however, must be determined more definitely by test.

"The natural gas of this country frequently contains light products that do not condense in the second-stage compressor, and for which it is practicable and necessary to instal three, four, and even higher stage compressors. These light products—true gases at ordinary temperatures and pressures—can be compressed and liquefied, but the liquid gases so obtained must be handled as gases and not as oils. The mistake heretofore made in the 'natural gas gasoline' industry, as some have recognised, has been the attempt to handle the light gaseous products as oils and not as gases. Until the manufacturers of this lightest third of fourth-stage compressor product recognise its gaseous nature, the absolute necessity for insuring the safety of the public involves certain restrictions in its transportation, and not until the realisation that this extremely volatile liquid should be handled only in strong steel containers capable of withstanding high pressures, will it be transported with safety."

HOME COLONISATION IN JAPAN.

The *Monthly Bulletin of Economic and Social Intelligence* contains an interesting article upon home colonisation in Japan, which is here summarised briefly.

The writer has considered it convenient for his purpose to divide the territory of the Empire into three parts and to examine the question separately for each part. The territory is divided thus: (1) Japan Proper; (2) Hokkaido (Yezo) and Sakhaline; (3) Korea.

(1) *Japan Proper.*—The characteristic features of this division of the Empire are farm lands worked from remote antiquity, a dense population, and landed property very much subdivided. Home colonisation tends to the formation of holdings of medium size, not by the transformation of large estates (of which there are scarcely any), but by the union of scattered parcels belonging to the same owner and the utilisation of the boundary land between one parcel and another. Home colonisation, therefore, in this part of the Empire is essentially farm land readjustment.

After dealing briefly with the history of rights in rural property in Japan, and outlining the actual economic situation of the proprietors and the present development of agriculture in Japan proper, the writer turns his attention to the question of the amount of cultivable land, and presents the following figures: Land under cultivation, 5,223,000 chô (1 chô being equal to 0·99 of a hectare); grazing grounds and uncultivated land, 1,868,000 chô. In Japan proper, that is to say, only 73 per cent. of the area adapted to cultivation is, in fact, cultivated, while 27 per cent. still remains to be brought under cultivation. Home colonisation in this territory has for its principal objects: (1) The readjustment of holdings of land already cultivated; (2) the utilisation of land at present uncultivated. With respect to the process of readjustment (or "restriping" as it is sometimes called) we shall content ourselves with reproducing some of the figures presented in the article in the *Bulletin.*

During the year ending August 31st, 1913, the number of new parcels of land dealt with under the law relating to readjustment was 765, representing a total area of 36,501 chô. The total number dealt with since 1900 is 5,503, with a total area of 320,451 chô. In these figures are included 171 parcels of land with respect to which the work of readjustment has been completed and the respective societies occupied with the operations have been dissolved.

The total number of individuals undertaking farm land readjustment and of members of associations for that purpose and for the reclamation of waste land reaches the somewhat high figure of 522,316. As regards the progress of the work, the position on August 31st, 1913, was as follows.

A report for the period ending August 31st, 1912, showed that only for 8·3 per cent. of the parcels (12·3 per cent. of the area) had the work been commenced. At the present time the work is being carried out on 42·8 per cent. of the parcels (59·4 per cent. of the area), and has been terminated on about 48·9 per cent. of the parcels in connection with which it had been begun. The total area readjusted is, however, only 26·3 per cent. of that of the parcels in question. The following figures, among others, are presented in the article in question, with respect to the work of reclamation of waste lands. According to recent inquiries carried out by order of the Department of Agriculture and Commerce at Tokyo, the area shortly to be reclaimed is about 72,000 chô to be transformed into rice fields, and 306,000 chô to be converted into fields temporarily irrigated, altogether 378,000 chô of new land, now uncultivated or covered with forest, belonging partly to the

State and partly to private owners. In addition, during the year 1912, 91,684 forest lots of a total area of 15,600 chô were dealt with. Of this area 10,955 chô were adapted to the cultivation of permanent crops, 3,678 chô to rotation crops, and the remainder were utilised for the erection of dwelling-houses and for various other purposes—*e.g.*, for cemeteries, for the erection of temples, etc.

Hokkaido.—This part of the territory of the Empire is very thinly populated, and the land is either not cultivated or cultivated in a very primitive manner. Home colonisation here has for its object the formation of small and medium-sized holdings, and this object it is sought to achieve by encouraging immigration and by conceding land for purposes of reclamation. It is in this part of the Empire that the work of home colonisation is proceeding with greatest activity, and at the same time most nearly resembles, in its methods and objects, the process of home colonisation as the term is usually understood in European countries.

The history of the work may be divided into three periods—namely, the period of feudal dominion; the period of the Colonial Department (*Kaitakushi*); and the period of the Government of Hokkaido (*Hokkaido-chô*). The work carried out by the *Kaitakushi* or Colonial Department is of outstanding importance, and may be divided into: (1) Measures for obtaining the labourers necessary for agriculture, such as free grants of food supplies, implements, or money to immigrants, concessions of land, etc.; (2) measures for the reclamation and improvement of the land through exemption from taxation, special facilities for buying, etc.; (3) prizes and rewards.

With respect to the results obtained, it will be sufficient to note that, during 1912, the number of immigrants into this district was 61,156, as against 13,963 emigrants, giving thus a net increase of population of 47,193.

It will be seen that the number of people who leave Hokkaido each year to return to Japan proper is still very considerable. This is due to many causes, not the least important of which is the comparative severity of the climate to which the Japanese cannot always adapt themselves, especially those Japanese from the Southern provinces accustomed to mild and temperate and even warm climates.

From another part of the article which is here summarised we learn that in this region small holdings are most numerous, while, on the other hand, large holdings cover most of the area. But under the special economic conditions of agriculture in this region, even farms of more than 50 hectares may be considered large, and thus large holdings assume an even greater importance. This leads to the inconvenience of the lease of farms by large proprietors to small farmers.

While in 1886, in fact, farms worked by the owners represented 82 per cent. of the total number of farms, in 1912 the proportion had fallen to 43 per cent.

Korea.—Land in Korea also is cultivated only partially or imperfectly; the population is sparse; the supply of water is badly utilised; and, while large areas have been denuded of timber, there are still extensive forests. Colonisation is limited almost exclusively to reclamation work without any special attempt to create small or medium-sized farms; and important work for the better utilisation of the water supply is being carried out.

The encouragement of emigration from the mother country is also characteristic of the work of colonisation in Korea, the Japanese Government being anxious to establish as large a number of colonists as possible in the newly-acquired territory.

INDIAN TOBACCO.

A Bulletin just issued by the Agricultural Research Institute, at Pusa, by Mr. and Mrs. Howard, who have done much valuable economic botanical work in India, recalls the strides that in recent years have been made in the improvement of tobacco cultivation in India, particularly in Bihar. There are none in India now who remember the Chinsurah cheroot, the manufacture of which, apparently, languished after the Dutch disappeared from India; but if it was made from the crude Indian tobacco, it could not have been a very delectable weed. There may be some, though, who remember the attempt of a Calcutta firm who, about thirty years ago, tried to introduce at Pusa the manufacture of pipe tobacco from indigenous leaf. The best that can be said of the result is that, as a smoke, it left much to be desired, and attempts to popularise it in Calcutta failed. Since then we have heard of more than one attempt to grow and cure a tobacco in India, both in Bihar and South India, that will take the place of the American tobacco that forms so large a part of the cigarette and pipe tobacco imported into this country. . . . In 1910 or thereabouts several of the tobacco factories came into existence, and cigarettes made from Indian tobacco began to find their way into the market. The best known of these is the Peninsular Tobacco Co., with factories at Monghyr, Bangalore, and other places. Having the huge and wealthy Trust, the Imperial Tobacco Co., behind it, the Peninsular Tobacco Co. has been able not only to undertake the manufacture of cigarettes on a gigantic scale, but to experiment on its own account and to co-operate with the Department of Agriculture in trying to secure a tobacco of fixed and uniform grade suitable for the making of cigarettes. The Bulletin under notice, and a previous one by

the same authors, are largely an account of these experiments. After many discouragements and in the midst of many difficulties of cultivation and curing, it has been possible to secure what was desired. A type of Indian leaf has been discovered which has the light colour, the fine texture, and the necessary elasticity when cut to make good fillings for cigarettes, and the flavour and aroma are said to be fair. In making these experiments imported varieties of American tobacco did not, under the altered conditions, reproduce the qualities desired, and the Indian varieties gave more promising results. The main reason for this was that the American varieties were not quick growers, an imperative necessity in Bihar, where the tobacco must be planted and cut in a few months towards the end of the year. In securing a tobacco of sufficiently high grade for the manufacture of cigarettes, it goes without saying that promising results have been secured in the improvement of other varieties of tobacco, which was a consummation much to be desired, because we are reminded that from an economic point of view there are obvious drawbacks to the production of a high grade cigarette tobacco only. The only customer in Bihar for this tobacco is the Peninsular Tobacco Co., as the local dealers do not require this product.—*Madras Mail.*

PHILIPPINE COPRA.

A recent report prepared by the Bureau of Insular Affairs, War Department, Washington, states that the Philippines a few years since were the leading source of the world's copra supply. But the coconut plantations were so seriously injured in 1912 that this youngest and heretofore most rapidly developing of the leading export industries of the islands received a check from which even now it is only beginning to recover, and Philippine copra is still far below its tonnage record of the past.

The unprecedented drought in the early part of 1912 interfered with the flowering of the palms, while storms of great violence swept the plantations during the autumn. As about a year is required for maturing the nuts the double disaster of that year has had a far-reaching effect on exports, which, from 140,536 long tons in 1912, dropped to 80,920 in 1913, with only a nominal recovery to 85,965 in 1914. While war conditions have doubtless tended to check normal trade movement and obscure this recovery in production, exports from August to December, 1914, amounted to 46,836 long tons, against 37,967 in the same period of 1913, and but for price conditions and the disturbed demand of the world market, the forecast is favourable for early resumption of normal output.

In the matter of prices during 1914 the industry fared badly, and the value realised on the slightly larger quantity, amounting to \$7,980,270, was \$1,565,454 below that of 1913. The increasing demand for coconut oil, and its growing use for food preparations in addition to its employment for industrial purposes, which has led to the rapid extension of Philippine copra production, has been characterised by a remarkably steady advance in copra export prices from about 2 cents per lb. a decade ago to over 5½ cents in the closing months of 1913. But a decline was already noticeable in the opening months of 1914, with prices that by July had reached 4½ cents, and the war was doubtless the leading factor in further declines that took export prices below 3½ cents—a reduced remuneration that may tend to affect production of copra even though indications point to an early normal yield of coconuts.

The reduced copra trade of the past two years is subject to some qualification, in view of the development of an export manufacture of coconut oil, which figured as a new item in the trade in this period. A manufacturing plant newly installed at Manila began to make shipments in the early part of 1913, and this new export item has steadily grown in importance, amounting to over \$2,500,000 in 1914. The exports of oil may be roughly estimated to represent the consumption of some 8,000 tons of copra in 1913 and 20,000 in 1914, and these amounts should be considered in connection with the small copra tonnage of those years. The oil trade has been almost exclusively with the United States from the beginning. Exports of the by-products of oil cake have also been a feature of this new manufacturing industry, and were exclusively to Germany, but ceased entirely in July.

OBITUARY.

ROBERT FELLOWES CHISHOLM, F.R.I.B.A.—Mr. Robert F. Chisholm died at his residence in Southsea on May 23rd. He was born in 1839. His father was a black-and-white artist, and he inherited artistic abilities and was a draughtsman of a high order. He was apprenticed to an architect, but an attractive offer having been made to him when he was about twenty years of age, he went out to Calcutta as a railway engineer in 1859. A few years later the attention of the authorities in Madras was drawn to him by his success in an architectural competition, and shortly afterwards he was appointed consulting architect to the Government of Madras. Thenceforward his work was mainly architectural, although he continued to take a keen interest in everything artistic, music, painting, pottery, etc. He remained in Madras till his retirement, when for a short period he worked privately in Bombay and for the Gaekwar of Baroda. The Gaekwar's palace, which he designed, is generally regarded as one of the sights of the city.

Mr. Chisholm was distinguished by his singularly keen appreciation of Indian art, and he has been mentioned as one of the two Government architects who have done more than anyone else to adapt Indian architectural styles to the requirements of modern Government departments. His Christ Church at Cuddapah is considered one of the prettiest of the Madras country churches. He finally left India about 1900, and spent some years in London. His last architectural work was the Christian Science Church in Sloane Street. He retired some five years ago to Southsea.

Mr. Chisholm was elected a member of the Royal Society of Arts in 1896. He took a keen interest in the work of the Indian Section, and frequently spoke in the discussions, especially in those which dealt with artistic subjects. In 1911 he read a paper on "The Taj Mahal, Agra, and its Relations to Indian Architecture," for which he received the Society's silver medal.

JOHN AMORY TRAVERS. — Mr. John Amory Travers, of Tortington House, Arundel, died suddenly of heart failure on the 4th inst., at the age of sixty-seven. He was formerly a member of the well-known City firm of Messrs. Joseph Travers and Sons, Ltd. He was also Chairman of the North Borneo Trading Company, Ltd., and a Director of the Komata Reefs Gold Mining Company, Ltd.

As a prominent member of the Worshipful Company of Fishmongers, Mr. Travers took a deep interest in the Company's charities, being at the time of his death Deputy-Chairman of the Governors of Gresham's School at Holt, in Norfolk. This school was founded in 1554, and is carried on for the higher education of boys under a scheme of the Charity Commissioners.

About ten years ago, when negotiations were proceeding for the proposed amalgamation of the Society of Arts and the London Institution, Mr. Travers was a strong supporter of the scheme, and he was one of the six representatives of the Institution on the joint committee, composed of representatives of the two bodies, which was appointed to consider the matter, and which reported in favour of amalgamation. He was at that time a member of the Society of Arts, having been elected in 1894.

NOTES ON BOOKS.

THE BOOK OF THE FLY. By G. Hurlstone Hardy. London: William Heinemann. 2*s*. 6*d*. net.

Just over a year ago Dr. E. Halford Ross read a paper before the Society on "House-flies and Disease." It was followed by an interesting discussion and some correspondence, to which Major Hardy contributed, and this volume owes its existence in some part to that discussion.

We are hearing a good deal at present about flies and their insanitary habits, which are likely to prove more than usually dangerous at a time when war is being waged over the greater part of Europe, when camps are scattered over a continent, and when the usual sanitary precautions can hardly be taken. The *Journal* has done what it could to spread a knowledge of these injurious creatures, and in a recent number was described the excellent Fly Exhibition now open at the Zoological Gardens, where the visitor may obtain an admirable object-lesson on the ways of these disease-spreading creatures. It is not everyone, however, who can get to Regent's Park, and one must give a cordial welcome to a book which gives so good an account of the fly as Major Hardy presents to us.

Although the fly has long been suspect among men of science, to the uninitiated it has been a harmless, or at worst an annoying, insect. It is high time that the general public should be educated to understand the perils it may bring with it. This task Major Hardy's book is well fitted to perform. It is written in a popular and readable style, and conveys a great amount of information about the various species of fly without being in any way overburdened with technical terms.

Readers of the *Journal* will hardly need to be reminded of the foul habits of the domestic fly how it haunts the most obscene places, and then makes its way, its hairy legs covered with germs and filthiness, direct to our breakfast tables, to leave a trail of possible disease and certain pollution over the sugar basin and the butter dish. All this is well described by Major Hardy, together with a clear physiological account of the various species of fly and their methods of reproduction. It gives one to think when the author mentions that the progeny of a single pair of house-flies may number 500 after one month, 125,000 after two months, and after three months many millions.

INDUSTRIAL TRAINING. By N. B. Dearle. London: P. S. King & Son. 1914.

This book is one of the monographs on subjects connected with economics and political science issued by the London School of Economics under the editorship of the Hon. W. Pember Reeves. It is the result of a laborious and exhaustive investigation into the problems of unemployment in the London building trades, and afterwards extended into the general conditions of technical education in London. It contains a vast amount of information which will be of serious value to all students of these important subjects. It deals not only with industrial education as generally understood, but with all the methods by which the supply of labour is provided in London industries, including apprenticeship, technical instruction in various forms, and the common practice of picking up knowledge of a trade by mere imitation and seeing skilled workers at work.

The author must have given considerable time and careful thought to the acquisition and classification of the varied information he has collected.

This information might perhaps have been more serviceable had it been a little more condensed, for the subject is treated with such minute detail that it is really a little difficult to get anything like a general view of the whole. Still, any student who will take the trouble to follow Mr. Dearle through his long and careful inquiries will be rewarded by the amount of information provided.

THE YEAR-BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1915. London: The Wireless Press, Ltd. 3*s*. 6*d*. net.

The third issue of this useful year-book is a thick volume of some 800 pages, and contains an immense amount of information relating to wireless telegraphy. The great bulk of this, naturally, is of a purely technical kind. Thus we have some 200 pages devoted to laws and regulations of various countries, from the Argentine Republic to Uruguay; about 200 pages are filled with particulars of the various wireless telegraph stations (land and ship) throughout the world; and a long alphabetical list is given of the call letters allotted to these stations. But in addition to these technical details there are a number of articles of more general interest which will appeal to the scientific reader. Professor J. A. Fleming, F.R.S., writes on "The Function of the Earth in Radiotelegraphy"; Mr. H. J. Round on "Wireless Telephony"; Dr. W. Eccles on "International Wireless Telegraphic Research during 1914"; Mr. Archibald Hurd on "Wireless and War at Sea"; Colonel F. N. Maude on "The Influence of Wireless Telegraphy on Modern Strategy"; Mr. A. H. Morse on "Some Applications of Radiotelegraphy"; Mr. R. G. K. Lempfert on "The Application of Wireless Telegraphy to Meteorology," and Mr. Arthur R. Hinks, F.R.S., on "Wireless Telegraphy in Survey."

The year-book has now established its reputation as a thoroughly sound and practical publication, the value of which is well recognised in the wireless world.

MICROMETERS, SLIDE GAUGES, AND CALIPERS. By Alfred W. Marshall, M.I.Mech.E., and George Gentry. London: Percival Marshall & Co. 6*d*. net.

This little handbook forms one of the excellent "Model Engineer" series. The information contained in it has already appeared in the pages of *The Model Engineer*, having been written in reply to inquiries from readers for instruction in the use of fine measuring appliances. It is impossible to exaggerate the value of minutely exact measurement to the engineering mechanic of to-day, and a thorough knowledge of accurate measuring instruments is essential to his success. The principles of micrometers and verniers are very clearly and practically explained by the authors; and the ways are indicated in which mistakes are liable to occur. The illustrations are numerous and good, and help materially to make the text easily comprehensible to the student.

GENERAL NOTES.

AGRICULTURE IN ENGLAND.—Some interesting facts bearing on the great agricultural industries of this country are to be found in a return issued by the Board of Agriculture and Fisheries on "Acreage and Live Stock Returns of England and Wales." From this it appears that of the 37,139,153 acres which make up the total area of England and Wales, 27,114,004 acres were under crops and grass on June 4th last. This is 15,378 acres less than in 1913, and the smallest total returned in any year since 1877. The decline is attributable in the main to the increase in the urban area, and to the constantly expanding demand for land for industrial purposes. A noticeable point, however, is the slackening of the rate of decrease. In addition to the area strictly under crops or grass there are two other categories of land of an agricultural character, namely woodlands and mountain or heath land, which, while the herbage is too sparse or of too poor a quality to be regarded as pasture, is nevertheless utilised for grazing. This latter area was returned in 1914 as 3,781,565 acres, or some 23,500 acres less than in 1913. The inquiry as to the acreage of woodlands was not repeated in 1914, but, assuming that the figure of 1,884,068 acres returned in 1913 has remained practically constant, it would appear that 32,779,637 acres, or 88 per cent. of the total area of England and Wales, is either under cultivation, grazed, or woodland. The total number of agricultural holdings of over one acre in 1914 in England and Wales, viz., 435,124, shows a reduction of 553 as compared with the previous year, a diminution naturally accompanying the decline in the total agricultural area. Holdings of the two smallest classes (1 to 5 and 5 to 20 acres) both show some reduction, but all the other remaining groups show slight increases. The total area under wheat, barley, and oats in England and Wales in 1914 was 5,241,895 acres, or 6,751 acres greater than in 1913. Wheat showed an increase of 105,910, while barley and oats were reduced by 54,085 and 45,074 acres respectively. The acreage under potatoes, 461,621 acres, was 19,586 acres greater than in 1913, and 29,587 acres above the average of the previous ten years. The total number of cattle in 1914 was 5,877,944, an increase of 161,000 as compared with 1913, and the largest number in any year, except 1911, since the returns were first collected. The number of sheep in 1914 was 17,259,694, an increase of 129,408 as compared with 1913, and, apart from that year, the smallest number on record. Of pigs the total number was 2,481,481, which was 379,379 greater than in 1913, and under one per cent. less than in 1912.

FOREIGN MACHINERY IN THE YANGTSZE VALLEY.—According to the American Consul of Chungking, there is an increasing demand in the Mienchow district (Szechuan Province) for articles of foreign manufacture. More sewing machines are sold

than ever before, and there is a good field for knitting machines. Pumping plants could be used not only for irrigation, but for pumping out flooded mines and for raising brine from the salt wells. Modern evaporating machinery could be used to advantage. With present methods it takes three to fifteen years to bore the deepest salt wells; with modern equipment the same work could be done in a few months. There is not likely to be much demand for agricultural machinery, as farms are all too small and labour is too cheap to make such an innovation profitable. Machinery for silk and cotton spinning and weaving could be used to advantage. The greatest obstacle to the development of the district is lack of capital. The Chinese recognise that many improvements are needed, but they seldom have the money necessary to instal them. As the profitable nature of many of these enterprises is well known, it should be possible for foreign companies to sell machinery accompanied by a loan that would be amply secured by the equipment.

New Rubber-curing Process.—A new departure in rubber-curing is described in the *Malay Mail*. The process does not embody any revolutionary changes from present practice so far as coagulating, crêping, or sheeting are concerned. These stages are carried out as before, but a great reduction in the time is claimed to be effected by turning out the sheet or crêpe much thicker than now. The crêpe, or sheet, to quote the specifications, is taken and introduced on top of a movable belt which, rotating in a particular direction, passes under a specially shaped jaw of a hinged top plate, thus imparting a rolling action to the sheet or crêpe. The commencement of the roll having now been attained, this action continues until the formed roll of rubber reaches a certain point in the machine and is ejected. The roll is smoked overnight, and is then ready for shipment. It is claimed by the co-inventors, Mr. Shelton Agar, manager of Kamuning Estate, and Mr. W. T. Platt, of Messrs. Guthrie & Co., Limited, that by the adoption of this machine and the attendant necessary slight changes from prevailing smoking methods, not only will drying sheds become unnecessary, but the finished product will be a better quality. An estate's whole output can be despatched forty-eight hours after tapping. In addition, grades of rubber are reduced to two, viz., one grade for the latex section and one for the scrap.

Asbestos in Tasmania.—The results of the geological reconnaissance of the country between Cape Sorell and Point Hibbs, on the west coast of Tasmania, are given in Bulletin No. 18 of the Geological Survey of that State. Asbestos occurs in this area in a belt of serpentine rocks which outcrop on the southern shore of Macquarie Harbour, at a locality known as Asbestos Point, and a company has been formed to investigate the extent of the asbestos-bearing zone. Trenches cut across the deposit show ramifying veins of chrysotile asbestos varying in width from an inch down to a mere paper-like film. The asbestos fibre is of good quality, and is stated to compare favourably with Canadian asbestos.

MEETINGS FOR THE ENSUING WEEK.

Monday, June 14...Geographical Society, Burlington-gardens, W., 8.30 p.m. Dr. Filippo de Philippi, "Expedition to the Karakoram and Eastern Turkestan."

Tuesday, June 15...Statistical Society, 9, Adelphi-terrace, W.C., 5 p.m. Messrs. B. Mallet and H. C. Strutt, "The Multiplier and Capital Wealth."

Wednesday, June 16...Meteorological Society, 70, Victoria-street, Westminster, S.W., 4.30 p.m. 1. Professor H. H. Turner, "Discontinuities in Meteorological Phenomena." 2. Mr. C. Harding, "Battle Weather in Western Europe, nine months, August, 1914, to April, 1915."

Microscopical Society, 20, Hanover-square, W., 8 p.m. Mr. F. Enock, "On the British Trap-door Spiders."

Thursday, June 17...Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Linnean Society, Burlington House, W., 5 p.m. 1. Mr. B. Cummings, "Colonel Montagu, Naturalist." 2. Dr. G. Henderson, "The fibre of *Calotropis procera*, and the cultivation of the plant from an economic point of view." 3. Mr. J. Hopkinson, "The structure of the Rhizopod test." 4. Mr. E. T. Browne, "Medusæ from the Indian Ocean, collected in 1905" 5. Professor A. Dendy, "Report on the Hexactinellid Sponges (Triaxonida) collected by H.M.S. 'Sealark' in the Indian Ocean" 6. —, "Tetraxonida." 7. Mr. J. C. Robson, "On the Cephalopoda obtained by the Percy Sladen Trust Expedition to the Indian Ocean in 1905."

Chemical Society, Burlington House, W., 8.30 p.m. 1. Messrs. T. M. Lowry and P. C. Austin, "The rotatory dispersive power of organic compounds. Part VIII.—Tartaric acid and the tartrates." 2. Mr. B. B. Dey, "A study in the coumarin condensation." 3. Mr. H. K. Sen-Gupta, "The formation of heterocyclic compounds from hydroxymethylene ketones and cyanoacetamide." (Part I.) 4. Messrs. T. M. Lowry and V. Steele, "Nitrocamphor and its derivatives. Part VIII.—The action of formamide on nitrocamphor." 5. Messrs. G. Senter and H. Wood, "Reactivity of the halogens in organic compounds. Part VIII.—Interaction of alkalis and alkali bromoacetates and bromopropionates in methyl alcohol solution and in mixtures of methyl alcohol and water." 6. Messrs. T. M. Lowry and R. G. Parker, "The properties of cold-worked metals. Part II.—Methods of measuring small changes of density produced by annealing."

African Society, Hotel Cecil, Strand, W.C., 8 p.m. Mr. H. W. Fox, "Rhodesia and the War."

Friday, June 18...Water Engineers, Institution of, at the Geological Society, Burlington House, W., 3 p.m. 1. Mr. H. Dewey, "The Effect of Springs upon Water-levels in the Chalk of Eastern Surrey." 2. Mr. P. Griffith, "The Hydro-Geological Conditions of Newbald, East Yorkshire."

Astronomical Society, Burlington House, W., 5 p.m.

Historical Society, 22, Russell-square, W.C., 8.30 p.m. Colonel E. M. Lloyd, "Some Episodes of Waterloo as Illustrations of Historical Evidence."

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FRIDAY, JUNE 18, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Sixty-first Annual General Meeting, for the purpose of receiving the Council's report and the Treasurers' Statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new Fellows, will be held, in accordance with the By-laws, on Wednesday, June 30th, at 4 p.m.

(By order of the Council),

HENRY TRUEMAN WOOD, *Secretary.*

SPECIAL WAR LECTURES.

The Council have arranged with Professor Vivian B. Lewes to give a short course of special lectures during the recess on "Modern Munitions of War." Three lectures will be given at 4.30 p.m. on Wednesday afternoons, July 7th, 14th, and 21st.

The first lecture will deal with "Guns and Propellants," the second with "Mines, Shells, and High Explosives," and the third with "Poison Gases and Incendiary Bombs." The course will be given under the Fothergill Trust.

The lectures will be open to all Fellows of the Society, who can admit their friends personally, or by the usual tickets. Any Fellows requiring further tickets can apply to the Secretary, who will furnish them with any number they may desire for distribution. Tickets will also be issued gratuitously to any persons interested in the subject who may apply to the Secretary.

EXAMINATIONS, 1916.

The first Examinations in 1916 will be held from April 10th–19th, and the second from May 29th–June 7th, inclusive. The last days for receiving entries will be March 13th and April 28th, respectively.

THE VALUE OF BIRDS TO MAN.*

By JAMES BUCKLAND.

NUMBER, FECUNDITY, AND VORACITY OF INSECTS.

Man imagines himself to be the dominant power on the earth. He is nothing of the sort. The true lords of the universe are the insects. While it is true that man has invented and perfected so many destructive agencies that he has attained to a predominance over the most fierce and powerful mammals and the most deadly reptiles, it is also true that in face of an attack of insects he and all his works are set at naught.

Few people know how enormous is the number of insect species or how amazing is their power of multiplication. The number of insect species is greater by far than that of the species of all other living creatures combined. Over 300,000 have been described, and it is considered not improbable that twice that number remain to be described. Practically all living animals, as well as most plants, furnish food for these incomputable hordes.

The fecundity of certain insect forms is astounding, the numbers bred reaching such prodigious proportions as to be almost beyond belief. Riley once computed that the hop aphis, developing thirteen generations in a single year, would, if unchecked to the end of the twelfth generation, have multiplied to the inconceivable number of ten sextillions of individuals. Noting the preceding, Forbush says if this brood were marshalled in line, ten to the inch, it would extend to a point so sunk in the profundity of space that light from the head of the procession, travelling at the rate of 184,000 miles per second, would require 2,500 years in which to reach the earth.

Kirkland has computed that one pair of gypsy moths, if unchecked, would produce enough

* Reprinted from the Report of the Smithsonian Institution.

progeny in eight years to destroy all the foliage in the United States.

A Canadian entomologist states that a single pair of potato bugs, or Colorado beetles as we call them, would, without check, increase in one season to 60,000,000. At this rate of multiplication the disappearance of the potato plant would not be long delayed. The chinch bug, a fecund and destructive pest, has been found in a clump of grass 8 in. in diameter to the number of 20,000. The progeny of this colony alone, if unchecked, would soon become incomputable hordes, devastating wide areas of the earth's surface. Those of you who have been in South Africa probably have seen locusts in flight which filled the air and hid the sun. What a potency for evil lies hidden in the tiny but innumerable eggs of these ravening pests! If every egg was permitted to hatch and every young locust to come to maturity, the consequences would be too dreadful to contemplate.

The voracity of insects is almost as astounding as their power of reproduction. The daily ration in leaves of a caterpillar is equal to twice its own weight. If a horse were to feed at the same rate, he would have to eat a ton of hay every twenty-four hours. Forbush says that a certain flesh-feeding larva will consume in twenty-four hours 200 times its original weight, a parallel to which, in the human race, would be an infant consuming, in the first day of its existence, 1,500 lbs. of beef. Trouvelot, who made a special study of the subject, affirms that the food taken by a single silkworm in fifty-six days equals in weight 86,000 times its original weight at hatching. What a destruction this single species of insect could make if only a one-hundredth part of the eggs laid came to maturity!

Mission of the Birds in Organic Nature.

Who or what is it that prevents these ravening hordes from overrunning the earth and consuming the food supply of all? It is not man. Man, by the use of mechanically applied poisons, which are expensive, unnatural, and dangerous, is able to repel to an extent the attacks on his orchard and garden. Out in the fields and in the forests he becomes, before any very great irruption of insects, a panic-stricken fugitive. Neither is it disease, or the weather, or animals, or fungi, or parasitic and predaceous insects within their own ranks. However large may be the share of these particular natural agencies in keeping insects in check, experience has shown that it is lamentably insufficient. Then what is it? The bird. Bird life, by reason of its predominating insect diet, is the most indispensable balancing force in nature.

Man at War with Nature's Laws.

Yet man has been engaged in the past half century in the blind and wanton destruction of this essential part of nature's great plan. He has taken no thought of the needs of the hour, nor concerned himself with the wants and claims of those to come. Within the space of a few years, under no constraint of necessity, he has carried out a policy of destruction more effective than that accomplished in centuries by the slow processes of nature. Armed with a weapon that annihilates space, he has constituted himself the master and the ruler of the animal world, and has delegated to himself the right to adopt a utilitarian standard by which he measures the value of all other forms of life. It is not for man to say what shall live and what shall be destroyed. The whole system of nature is in exquisite poise, and it is not possible to lay rough hands upon it without disturbing it in directions and on a scale which at the time may not be guessed at. If we remove or reduce the working power of one living organism which acts as a check on another, the latter, freed from restraint, will inevitably multiply. As we destroy the insect-eating birds the insects on which they prey will multiply to scourge us as Egyptian plagues.

Serious Consequences of Bird Destruction.

Some years ago the agriculturists of Hungary, moved to the insane step by ignorance and prejudice, succeeded in getting the sparrow (*Passer domesticus*) doomed to destruction. Within five years the country was overrun with insects, and these same men were crying frantically for the bird to be given back to them, lest they should perish. The sparrow was brought back, and, driving out the hordes of devastating insects, proved the salvation of the country.

In the Island of Bourbon once, because of the same ignorance and prejudice, a price was set on each martin's head. The birds all but disappeared, and grasshoppers took possession of the island. The edict of banishment was hurriedly revoked and the exile recalled. Fortunate, indeed, was it for the Island of Bourbon that the bird was not beyond recall.

During the year 1861 the harvests of France gave an unusually poor return, and a commission was appointed at the instance of the Minister of Agriculture to investigate the cause of the deficiency. By this commission the deficiency was attributed to the ravages of insects which it was the function of certain birds to check. These birds, it appeared, had been shot, snared, and trapped throughout the country in such numbers that but little repressive influence had been exerted upon the insects. It was concluded that by no other agency than the birds could the ravages of insects be kept down, and the commission called for prompt and energetic remedies to prevent the destruction of birds.

For some years prior to 1877 vast numbers of red-winged blackbirds were poisoned in the spring and autumn around the cornfields of Nebraska. This was done in the belief that the blackbirds were damaging the crops, especially the wheat. Great numbers of prairie chicken, quail, plover, and various other insect-eating species were destroyed at the same time by eating the poisoned grain. Then came 1877, and with it Nemesis. The locusts appeared in countless numbers. There were no birds to eat them, and Nebraska mourned.

In 1895 the ravages of two species of cut-worms and some ten species of locusts produced a famine in the region of Ekaterinburg, which is in Russian Siberia. The local Society of Natural Sciences inquired into the cause which had permitted such a numerous propagation of insect pests, and reported that it was due to the almost complete destruction of birds, most of which had been killed and sent abroad by waggon loads for millinery purposes.

Those grass ticks which now make the keeping of most breeds of cattle impossible in Jamaica are not mentioned in the records of the early nineteenth century. The appalling destruction in more recent years of insect-eating birds, chiefly to supply the demands of the millinery market, has led to an inordinate increase of the ticks and to the dying out of all but Indian cattle. This correlation of birds and ticks - to say nothing of mosquitoes and other insect plagues in Jamaica—was put fully and circumstantially before the Secretary of State for the Colonies by a deputation in 1909.

E. D. Morel has recently pointed out how the reckless destruction of the guinea-fowl (*Numida*) in French West Africa is coincident with the increase of certain germ diseases, and, above all, with ravages to crops on the part of the larger insects, especially beetles, the grubs of which were devoured by the guinea-fowl, which scratched them out of the ground.

Though I could give a hundred cases similar to the foregoing, I must rely on the few I have cited to show that the wholesale destruction of birds is surely followed by disaster to man.

Value of the Bird in checking Insect Irruptions.

When the Mormons first settled in Utah, their crops were destroyed utterly by myriads of black crickets that streamed down from the mountains. Promising fields of wheat in the morning were by evening as bare as though the land had not been sown. The first year's crop having been destroyed, the Mormons had sowed seed the second year, and again the crop promised well. But again the crickets appeared, devouring every blade of wheat, and the followers of Joseph Smith were on the verge of starvation. At this juncture Franklin's gull came by hundreds of thousands, and, feeding greedily on the crickets, freed the fields of the pest. The settlers at Salt Lake regarded the advent of the gulls as a heaven sent miracle, and practically canonised the birds.

Since that hour this black-headed gull has remained a faithful servitor of the farmers of Utah. A monument to this bird has been erected in Salt Lake City, thus showing a befitting and seemly sense of gratitude for its inestimable services in guarding the State from the ravages of insects.

It is a common practice with all settlers in a new country at once to set about killing the native birds in a thoughtless and foolhardy manner. This stupid practice is all the more deplorable, because an enormous increase of insect pests invariably attends the operations of the pioneer agriculturist. Finding in cultivated crops new and more succulent sources of food supply, insects change their primitive habits, to swarm and multiply exceedingly upon the fertile fields of man's creation.

When the farmers in New Zealand began to break the virgin soil on an extensive scale, a certain caterpillar, which hitherto had gleaned a somewhat meagre sustenance from the scanty native verdure of the open lands, disappeared from its old haunts and attacked the cultivated areas. So speedily did it increase by reason of a more favourable environment that it soon became a blasting plague. It came not singly, nor even in battalions, but in mighty armies which laid waste the land. I have seen these atoms cover the pastures in such numbers as to make the green one brown. I have seen countless millions of them pass out of one corn-field, having stripped every stalk bare, cross the road in solid phalanx, and pass into another. I have seen big mobs of sheep mustered in hot haste and driven to and fro over these serried ranks that they might crush them with their scurrying feet. I have seen every horse roller in a district brought up hurriedly, like steam engines to a fire, and drawn backward and forwards over the crawling masses until the cylinders stuck fast in a mire of squashed insects. I have seen huge ditches dug in an attempt to stop the invaders' progress. The effort was as futile as that of a child who builds a bank of sand by the sea, thinking it will stem the oncoming tide. Even railway trains were brought to a stand-still, the wheels of the engines being unable to grip the rails owing to the hordes of caterpillars which were crossing the line.

In time it became abundantly clear that if this disastrous condition of affairs continued it would be useless to attempt to carry on agriculture in New Zealand. Realising that any attempt which they might make to rid the smitten land of the plague would be but a mockery, the farmers turned their eyes longingly to the natural enemy of the caterpillar—the bird. But the native

birds—though they had lived in closest companionship with the Maoris—had been taught the treachery of the white man in a school that reeked with blood, and those that had not been killed had retreated from the vicinity of the settlements, visiting the insect-ridden fields occasionally only.

Wherefore insectivorous birds from the old country were introduced, and the one that multiplied most rapidly was the common house sparrow. And *Passer domesticus* soon cut short the career of the caterpillars.

As digestion is exceedingly rapid in birds, and as they feed for the most part throughout the day, they are peculiarly adapted for the suppression of abnormal outbreaks of vegetable as well as of animal life.

That formidable imported weed, the Scotch thistle, threatened at one time to overrun the whole of New Zealand. Much time and money was spent by the settlers in cutting off the plants close to the ground, and in pouring turpentine upon the split stumps, hoping thereby to kill the roots. Vain labour. The wind-driven clouds of thistledown, which were planting the weed far and wide, grew yearly denser and more frequent. At length the fields became a packed growth of prickly plants, which nothing could face.

The sparrows took to eating the seed. In tens of thousands they fed on it, giving it the preference of all other hard food, and the weed was conquered.

To-day in New Zealand the sparrow is looked upon as an impudent thief without a redeeming feature in its character. No one, of course, can say what would happen if the bird was dismissed from the country, though it is probable that the Dominion would be again overrun with caterpillars and thistles. Setting aside this hypothetical question, the good the sparrow does must far outweigh the evil. This statement receives confirmation in the bountiful harvests with which New Zealand is blessed. Never were the sparrows more numerous; never the complaints against them more bitter; yet the yield of grain is without precedent.

The growling of the New Zealand farmer at the sparrow justifies Virgil's complaint of the "miserly husbandman." Miserly, indeed, and blind. Not a grain will he give to the bird which has laboured unceasingly with him for the production of his crops; but whole fields of wheat to the caterpillar.

Parenthetically I may mention that, though I have written here in defence of the introduction of the European sparrow into New Zealand, I am not an advocate of acclimatisation. It is true that one can point to cases where a foreign bird has been introduced to perform the function of a native species that has been driven out, and where that function has been performed satisfactorily. But, as a rule, such substitutions are fraught with danger. Birds so rapidly change their habits in new surroundings that few species remain loyal to the reputation for honesty which they enjoyed in the land of their origin. Like most aliens, it would have been better had they remained in their own country. Although the spread of civilisation unconsciously demands some victims, man and indigenous birds can, speaking generally, occupy the same territory without much difficulty. If one requires proof of this, one has but to turn one's thoughts to British India, where native birds of all kinds, owing to the protection accorded them by the Hindu doctrine of the sanctity of all life, are found living in closest proximity to dense human populations.

The moral of all of which is that it behoves every man who has the welfare of his country at heart to do all in his power to foster native birds.

In Australia a plague of grasshoppers periodically visits the fields to devour the crops. The ruin they would otherwise bring on the farmer is averted by the good offices of ibises and other native birds. As a destroyer of grasshoppers, the straw-necked ibis (*Carphibis spinicollis*) has no equal among birds. Dudley Le Souef, the director of the Melbourne Zoological Gardens, some years ago visited a rookery of this bird in the Riverina, and, after a careful estimate, came to the conclusion that the minimum number of birds breeding there was 200,000. He procured a number of specimens, and ascertained by actual counting that the contents of an average crop of an adult bird were 2,410 young grasshoppers, five fresh-water snails, and several caterpillars, which, multiplied by 200,000, amounts to a total of four hundred and eighty-two million and odd grasshoppers, as well as vast numbers of caterpillars and snails. "Then, again," says Mr. Le Souef, "the average number of young is about two and one half to each pair of parent birds, and the contents of their stomachs must reach an enormous total, as they all seemed gorged with food."

As this enormous amount of food is being eaten every day by ibises in Australia during the hatching time of the grasshoppers, some little idea can be formed of the immense utility of those birds to the farmer. Without them the balance of nature would be disturbed and successful agriculture would be impossible.

In addition to its great value as a destroyer of all devouring insects, the straw-necked ibis feeds with avidity on the fresh water snail—the host of the dreaded liver fluke, which sheep so easily get in certain damp localities.

Were it not for the locust birds, who breed in localities in which the locusts have deposited their eggs, and who spend their lives in combating the locust peril, there are whole districts in South Africa in which agriculture would perish.

THE VALUE OF BIRDS IN FORESTS.

Omitting all mention of many another instance of the quelling of insect outbreaks by birds, I will pass at once to the consideration of those perennial services which act as a constant check on the undue increase of insects, rodents, weeds, and other pests.

Birds attain their greatest usefulness in the forests, because the conditions there closely approach the primeval.

Forest trees have their natural insect foes, to which they give food and shelter, and these insects in turn have their natural enemies among the birds, to which the tree also gives food and shelter. Hence it follows that the existence of each one of these forms of life is dependent upon the existence of the others. But for the trees the insects would perish, and but for the insects the birds would perish, and but for the birds the trees would perish; and, to follow the inexorable laws of nature to the conclusion of their awful vengeance, but for the trees the world would perish.

Consider for a moment the life of a tree in connection with the insects that prey upon it. At the very beginning, before the seed or nut has germinated, it may be entered by a grub which destroys it. Should, however, the seed or nut be permitted to grow, the roots of the seedling may be attacked by beetles. Escaping this danger, a worm lays its eggs in the cracks of the bark. On hatching, the worm or borer perforates a hole in the stem. This hole, admitting water from every passing shower, causes a decay in the wood to commence, from which the tree may never recover. Other borers feed upon the bark, eating the soft inner layer and the sap. The twigs are affected by the larvæ of certain beetles, which act as girdlers, sometimes destroying limbs over an inch in diameter. Weevils bore under the bark and into the pith, making excavations in which the eggs are laid. For the same purpose the cicada makes a terrible wound, which often proves fatal. The limbs of trees are affected by aphides, which puncture them and feed upon their juices, exhausting the sap. Many species of plant lice and scale insects infest trees, doing great damage, while over one hundred different species of gall flies are parasitic upon them. The buds of trees are entered and destroyed by the larvæ of certain moths, while the leaves are devoured by caterpillars. To take the oak as an example, it is known that altogether over five hundred species of insects prey upon it. Finally, be it remembered that in the bark and in the underlying tissues lie the vital energies of a tree.

It is difficult to perceive the usefulness of these insects which feed on the different parts of the tree, though they may, perhaps, when in normal numbers, exert a useful influence by a healthful and necessary pruning. It is certain, however, that if they were not in turn preyed upon by birds they would so increase in numbers that the tree could not survive the injuries they would inflict.

How dependent trees are on birds for their existence may be gathered from the following illustration: As many of you probably know, trees breathe through their leaves. Consequently, if the buds of the leaves are prevented from developing, or are eaten, when developed, by caterpillars, the tree is weakened. Many coniferous trees will die if stripped of their foliage for one year. Deciduous trees, if deprived of their respiratory organs for several years in succession, will also perish, though these trees linger as a rule for two or even three years before finally succumbing.

Nor is injury to its breathing organs the only danger to which a tree afflicted in this way is subjected. The tree, being in a weakened condition, is at once beset by beetles and other borers, who, multiplying rapidly under such favourable conditions, tunnel under the bark until all the vital tissues of the poor tree are wasted. Thus a tree which might have recovered from the injury to its lungs falls a victim to the attacks of an insidious enemy which took advantage of its enfeebled state.

Woodpeckers or other birds of similar feeding habits would have flown to the rescue of the tree and possibly saved its life; but when that corrective influence is missing, the tree must die.

This illustration of the dependence of the tree on the bird and of the bird on the tree is, of course, but one of a long series that could be cited, and it is because of this most delicate adjustment between the tree, the insect, and the bird that I regard as profoundly true Frank M. Chapman's statement, "that it can be clearly demonstrated that if we should lose our birds we should lose our forests."

It is an ignorant schoolboy who does not know that if we lost our forests we should lose also the moisture necessary for the production of crops upon which man is dependent for his living.

If, in his arrogance and folly, man exterminated the bird, thinking himself capable of taking its place, he might be able to make shift with his sprays to save some portion at least of his orchards and gardens; but of what avail would be his efforts to protect from the insects the forests of America and Africa, the jungles of Asia, or the bush of Australia? Should he not, then, protect by every means in his power every one of the forest birds, who, as a matter of course and without trouble or expense to him, ordinarily accomplish, on his behalf, the herculean task of saving the lives of the trees? One would think so. Yet in these very regions there are being killed annually millions of the feathered guardians of the tree,

and killed, too, for no worthier purpose than that, dead, they may defame a woman's head.

The Value of the Bird in the Orchard.

For man's purposes the work of the bird in the orchard is not so thorough as that done by them in the forest. Birds are the slaves of nature, and, in the main, nature's endeavours are put forth only to produce such fruits as will insure the perpetuity of each species of tree. With man the case is altogether different. His main object is not the propagation of trees, but the production of a giant gooseberry. Moreover, by introducing arsenical spraying, tarred and greased bands, and other devices to counteract the evil action of insects, he has, to a certain extent, taken upon himself the office of the bird. In this he is wise, for it must be admitted that if he wishes a large crop of fruit he must himself prevent the inroads of those insects which attack the fruit directly. It cannot be expected of the bird that it will become an efficient ally of man in protecting the artificially produced fruit from the attacks of the numerous insects that are drawn to the orchard by a vastly increased quantity of fruit of a vastly better quality than the natural product.

For all that, fruit growers are largely indebted to the bird for a great part of their annual crop.

In the Union of South Africa, for instance, it is found that near towns, where the birds have been more especially persecuted and driven away, the growing of fruit and other market produce has become increasingly difficult, or even impossible, owing to the prevalence of insect pests which are not affected by spraying operations.

But let us suppose for a moment—though the supposition is absurd—that the modern fruit grower could do without the services of the bird. Would that give him a right to slay it? Apart altogether from the agriculturist, what of the millions of people who, as an increment to their ordinary livelihood, grow fruit, but who cannot afford either the time or the money to treat their trees in the most approved and scientific way?

What would happen to this poorer class of fruit growers if they were deprived of the services of the bird is best seen in what happened to Frederick the Great. This worthy, in a fit of passion because a flock of sparrows had pecked at some of his cherries, ordered every small bird that could be searched out to be instantly killed. Within two years his cherry trees, though bare of fruit, were weighed down with a splendid crop of caterpillars.

Call the bird in the orchard an evil, if you will; but it is a necessary evil, and the fruit grower must make up his mind to pay the bird its wages lest worse befall.

The Services of the Bird in the Garden.

The garden is the insect's paradise. It fares sumptuously every day on the most succulent of vegetable foods. Every opportunity is thus offered for its increase. The greatest insect enemy of the garden is a small, dull-coloured, hairless caterpillar known as the cutworm, which is the larva of a Noctuid moth. This chief of the brigand band of garden pests usually hides during the day beneath matted grass or under the loose soil along the rows of plants. It comes forth at dusk to feed. The bird is abroad at the first peep of day, and it finds the robber worm in the morning before it has retreated to its place of concealment.

But the early bird has to come stealthily to the garden to catch the worm. Its visits are regarded by man with more than suspicion, and it is fortunate if it escapes with its life. In consequence it snaps up a caterpillar and is off again, leavings thousands it would have eaten, if unmolested, to run riot amongst the vegetables.

Occasionally a bird more bold than its fellows will visit the garden in broad daylight to dig the cutworms out of their hiding-places. Nature never having begrudged it the reward of its toil, the bird takes a few peas before leaving.

The gardener notices the damage done to his peas, and next morning is up betimes. He sees the bird running along a row of peas, stopping frequently to peck at something on the ground. There is a loud explosion, followed by a puff of smoke. The smoke slowly drifts away to disclose a bird lying dead.

Caterpillars are not gifted with voice; if they were, they would scarce forbear to cheer.

The bird is dead. Mark the sequel. One fine morning the gardener issues proudly forth to cut his mammoth cabbage the one with which he intends to put to utter confusion all other competitors at the local fruit and flower show. Alas for human hopes, and the depredations of caterpillars! The cabbage is riddled like a colander.

The gardener when he shot the bird forgot, if, indeed, he ever knew, that the ancient law forbade a muzzle to the ox that thrashed out the corn.

Utility of Birds in the Meadow.

Each season, until hay-making commences, the grass offers cover and shelter for the nests of such birds as breed on the ground. The fields also provide food for birds, and for the insects on which birds feed. Thus there is established a natural interrelation and interdependence between the bird and its food and shelter—that is to say, the insects and the grass. This simulates the condition of the earth before man made discord in the grand harmony of nature's laws.

Where the birds of the field are undisturbed they tend to hold the grass insects in check. On the other hand, when the numbers of birds in the field are for any reason insufficient, the insects increase.

Here is an instance of this: Some years ago in Bridgewater, Mass., a great battue was held by the ignorant townspeople in the spring of the year, and so many field birds were killed that their dead bodies were ploughed into the land for manure. The following summer whole fields of grass withered away and died. This was due solely to the fact that the number of field birds had been reduced, and in consequence the pressure which nature demands the field birds shall exert upon the field insect had been released.

Again, at one time in New Zealand it was no uncommon thing to see English grass wither up in large parches, as though scorched by fire. This was due to the work of a crane fly and click beetle, the larvæ of both of which were addicted to the habit of eating the roots of the grass, just under the surface. English grass was then comparatively limited in the up-country districts, and, as there are large tracts of land in New Zealand destitute of native grasses, the depredations of these insects became a serious matter to those settlers who had stock to feed and who were relying on the English grass to feed it. It was all the more serious because the insects were without any natural check, the native birds which had kept them in subjection before the advent of the white man having been either killed or driven from the vicinity of the homesteads. So the beetles continued to make merry, to marry, and to multiply. In a corresponding ratio the grass continued to fade, to wither, and to die.

Then came the English starling, and so voraciously did it feed on the larvæ that soon all was green again.

A case similar to the foregoing occurred about five years ago in the Illawarra district of Australia, where, owing to the ruthless destruction of wild bird life, grubs took possession of the land, and, eating out the grass by the roots, transformed what had been a rich pastural country into an unprofitable waste.

Without the aid of birds grass could not be grown. The grub of a single species of beetle, if unchecked in its multiplication, could destroy all the roots in our meadows; or any one of the several species of cutworms, if its reproduction was not restrained by birds, might be sufficient to destroy all the verdure above ground.

Hawks and Owls.

The injury to trees, crops, and grass by insects is not the only evil that threatens man as a sequence to the destruction of birds. Rapacious birds hold a chief place among the forces which are appointed to hold in check small rodents, which breed rapidly, and unless kept within bounds are exceedingly destructive. Yet, notwithstanding the unanimous testimony of careful students of birds and their food habits to the effect that almost all hawks and owls are beneficial, a widespread prejudice still exists against them. They are slain as relentlessly as if they were enemies instead of friends of the farmer.

The destructive habits of the small rodents, which are the natural prey of hawks and owls, are much the same all the world round. They do an incalculable amount of damage to standing corn, to corn in the stock or when stacked, to grain, to root crops when growing or when piled on the ground or stored in pits, to orchards and forest trees, to the roots of clover and other grasses, to ground growing fruit, and to gardens, both flower and vegetable. In addition to this list of crimes, certain rodents are active agents in carrying and disseminating the germs of plague and other diseases.

Here in England though on account of their small size and secretive habits they are often undiscerned by man's dull eyes--they swarm in such numbers in the fields and hedgerows that the damage they do must prove a steady drain on the resources of the farmer.

The number of small rodents eaten by the rapacious birds is almost as remarkable in proportion to their size as is the number of insects eaten by small insectivorous birds. During the summer of 1890 a pair of barn owls occupied a tower in a building at Washington. After their departure there were found in the regurgitated pellets, with which the floor was strewn, 454 skulls of small rodents.

The young of hawks and owls remain a long time in the nest, and require a great quantity of food. During this period the resources of the parents must be taxed excessively in the effort to satisfy the hunger cravings of their offspring, and it is not to be wondered at if some individuals are forced occasionally to snap up a chicken. But what is the worth of the chicken, or of the young pheasant, occasionally taken, compared with the hundreds of thousands of pounds worth of damage that is wrought in the orchards and fields by rodents that hawks and owls, had they been spared, would have fed upon for the maintenance of their species?

In 1885 the Legislature of Pennsylvania passed an Act, known as the "Scalp Act," which provided a bounty of 50 cents each on hawks and owls killed within the State limits, and a fee of 20 cents to the notary taking the affidavit. As the result of this act, \$90,000 was paid in bounties during the year and a half subsequent to the passage of the Act. An irruption of small rodents followed, and did damage to the agricultural interests of the State amounting to \$3,850,000. And even these figures, enormous as they are, do not represent the entire loss.

Years must elapse before the balance of nature, which was destroyed, can be restored.

In Montana the destruction of hawks and owls was so complete that rodents, freed from the pressure of their natural check, became as one of the plagues of the Book of Exodus. Then the legislature passed a law offering bounties for the destruction of these four-footed pests. During six months of 1887 such large sums were paid out in bounties for the destruction of small rodents—a work that the hawks and owls had previously done free of charge—that a special session of the legislature was called to repeal the Act, lest it should bankrupt the State.

In 1907 Nevada went through a very trying experience with mice, while Utah, Wyoming, California, and several States farther east have all had occasion bitterly to rue the day that they shot their hawks and owls.

But the destruction of small rodents is not the only function of rapacious birds in the economy of nature. Several species are voracious insect feeders. Nor is this all. It is well known that when small insectivorous birds increase abnormally in numbers they, too, become a pest. Hawks and owls materially assist those other agencies of nature which act as a check on the undue increase of small birds. If rapacious birds were rigorously protected in this country we should have fewer complaints of the damage done by sparrows.

Birds of prey, if unmolested, not only prevent the overproduction of small birds, but they also confer a salutary benefit on each species on which they prey by checking the propagation of weakness or disease by killing off the sickly and most unfit individuals, for these are the most easily seen and the most readily captured. This is particularly true of game fowl, and one of the most plausible hypotheses explanatory of the occasional outbreaks of disease among grouse has been the removal of this corrective by ignorant gamekeepers.

Yet it is my belief that nothing but a miracle will ever make these men see the error of their ways.

The Economic Value of the White Heron.

The destruction of the white heron for its scapular plumes has robbed half the world of a bird which is most useful to man. It never touches grain, but feeds solely near water and over damp ground, the breeding places of innumerable batrachians, small crustaceans, and pestiferous insects, all of which directly or indirectly injuriously affect crops in the neighbourhood. The presence of the white heron in the rice fields, for instance, is distinctly beneficial to the farmer, and rice is one of the most extensively grown crops of India and of China.

In Australia the slaughter of this and other wading birds for their plumage is causing in that country a decline in its fish resources. It is the destruction of these birds which has led to the ever-increasing multitudes of crustaceans which destroy the fish spawn and the young fish hatching out in the Coorong and in the lakes at the Murray Mouth.

In his report on Egypt for the year 1912 Lord Kitchener stated that the indiscriminate destruction of bird life had allowed an enormous increase of insect pests, steps for the combating of which were to be taken. Lord Kitchener knew that in spite of the improved methods of fighting insects there was only one step that he could take that would be effective. A Khedivial decree was issued forbidding the catching or killing of, or taking the eggs of, Egypt's insectivorous birds. In issuing this decree the fact was not lost sight of that in the valley of the Nile the egret is one of nature's checks on the cotton worm.

White herons consume many flies, as well as the larvæ of insects in water. This fact is well known to those who have watched the habits of oxen and buffalo in Asia or Egypt. There the smaller white herons—the paddy birds of India—live with the oxen or the buffaloes, and pick the flies or the ticks from their bodies.

The late George Grenfell noted once on the Congo how a dying white heron, which he had shot and put into his canoe, roused itself, even on the approach of death, to snap at the tsetse flies which were settling on his boatman's legs.

Value of Birds to Live Stock.

The injury done to domestic animals by biting and parasitic insects is very great. Herds of cattle are often stampeded by these tormenting creatures, which carry disease and death among them. Another great affliction is the warble, which is a small tumour produced by the larva of the gadfly on the backs of cattle, and the constant irritation of which causes considerable depreciation in the value of hides, besides a lessened quantity and poorer quality of beef.

Horses, sheep, and other farm animals are subject to the attacks of similar parasites and other persecuting insect foes.

If it were not for the services the bird renders in alighting on animals in search of these parasites, or in catching the flies on the wing, or in eating them in the embryo state, man would be unable to keep his live stock.

More than this, man himself would be unable to inhabit many places on the earth which he now cultivates, or where he carries on other lucrative industries.

Shore Birds and Disease.

Deadly maladies are carried about by the myriads of mosquitoes and flies that abound on the coasts of tropical and subtropical countries.

Yet the shore birds, which render invaluable services to man by destroying these venomous pests, are thoughtlessly killed by him in countless thousands.

To his honour, be it said, one of the first acts of Mr. Wilson, when he became President of the United States, was to issue an Executive order prohibiting, under heavy penalties for infraction, the destruction of any wild bird in the Canal Zone.

Game Birds as Weed Destroyers.

Unquestionably weeds serve a useful purpose in nature, but that purpose is not the occupation of cultivated land. Without check they would speedily choke all grain to death.

Constant use of harrows and hoes will do much on farm lands and in gardens to keep down weeds, but as most earth is full of weed seed, which retains its vitality for years, the life of the tiller of the soil is one continuous struggle against these troublesome plants. In this battle the bird is of great assistance, for the number of weed seeds eaten by birds on cultivated land must be beyond any assignable quantity.

Game birds generally are the greatest eaters of weed seeds. They are also useful to man in several other ways. Not only do they devour mature locusts, but they scratch up and eat the eggs. They also consume in large quantities termites and other equally pernicious insects. The reckless shooting of game birds is to be deprecated. They are of far more use alive than in swelling the bag of the sportsman.

The quail is perhaps the greatest weed destroyer of all the game birds. It is doubtful, indeed, if the quail is not more useful to man than any other bird. It is very nearly wholly beneficial. During spring and summer it feeds on many of the most destructive of insects, and in autumn and winter it eats an enormous amount of seeds of many harmful weeds.

The report of the United States Biological Survey says :—

"It is reasonable to suppose that in the States of Virginia and North Carolina from September 1st to April 30th there were four quail to each square mile of land. The crop of each bird holds half an ounce of seed, and is filled twice a day. Since at each of these two daily meals harmful weed seeds constitute at least half the contents of the crop, a half ounce daily is consumed by each bird. On this basis the total consumption of harmful weed seeds by quail from September to April in Virginia and North Carolina amounts to 1,341 tons. As destructive insects form about one-third of the bird's food from June to August, quail consume 341 tons of these pests in these States within those two months."

But perhaps the most valuable service that quail render the people of the United States is the greedy way in which—and they stand almost alone among birds in this particular taste—they eat the evil-smelling potato bug.

In addition to this inestimable service, it is partially due to this bird that the cotton boll weevil has not swept over the entire cotton belt of America, bringing ruin to thousands of human beings on both sides of the Atlantic.

While speaking of the services which the quail renders to man, I may mention that there is—now that Great Britain has harnessed the Nile—a plain economic reason for our revolt against the present day practice of killing Egyptian quail, and shipping them abroad by hundreds of thousands to tickle the palate of gourmands.

The Bird as a Scavenger.

The fishing population of these islands has declared war on the gulls, and is demanding the withdrawal of certain species from the list of protected birds, on account of the damage they are alleged to do to the fishing industry. People who believe fishermen's tales are apt to be duped and led into repeated errors. The gull is a surface feeder. It may occasionally levy toll on useful fish, but to say that it does any appreciable injury to the fishing business is absurd.

On the other hand, the presence of the gull is essential to man's health. While the bird fulfils many useful minor offices – such as destroying larvae in land along the seaboard and in eating enemies of fish that are exposed during low tide —its chief function in the economy of nature is that of scavenger of the harbours and of the littoral, just as vultures are the scavengers of the mainland. The wholesale destruction of gulls for their plumage in Yucatan was followed by a great increase of human mortality among the inhabitants of the coast, which mortality was irrefutably due to the loss of the birds that had kept the harbours and bays free from the decaying matter which the sea is constantly casting ashore.

I wonder if these men who wish the gull destroyed ever give a thought to what would happen to their own villages if this bird was not present to eat the refuse they throw about? Or, again, if they ever reflect on that feeling of relief they experience when in thick weather they hear, through the fog, the clamour of these feathered bell buoys, warning them that they are nearing rock or bar?

The Bird as a Guano Producer.

Now that I am on the subject of pelagic birds, I will speak of their value as guano producers.

Undoubtedly the present enormous trade in fertilisers owes its origin to the bird, for the fertilising properties of the phosphoric acid and nitrogen contained in fish was not recognised until guano—which is the excrement of sea

birds mixed with fish—became a stimulus to intensive agriculture.

The value of guano as a fertiliser was known to the people of Peru in the time of the Incas, though the nineteenth century had dawned before the information was carried to Europe by Humboldt. Under the rule of the monarchs of old Peru the birds were rigorously protected and the guano deposits carefully guarded. Three centuries later these protective measures materialised in a source of revenue to the country. Generation after generation of sea birds had placed on their breeding grounds deposits of guano which, in 1853, were estimated by the Peruvian authorities to be worth $620,000,000.

It is our pleasure to think of the Incas as barbarians and to look upon their times as dark and rude. In our own enlightened age we allow the agents of the millinery interest to kill at one fell swoop over a quarter of a million sea birds on an island valuable for its guano deposits.

Value of Wild Bird Life as a Food Supply.

Under certain conditions wild bird life is invaluable to man as a food supply. The pioneer must—at any rate, at the commencement of his farming operations—live in great part on the wild products of the earth. In days gone by the forerunner of civilisation could confidently rely on his gun to keep his larder constantly stocked with edible birds. Now, in many parts of the world, he is confronted with an alarming scarcity of this kind of food. The great straits to which the pioneer of the future will be reduced on account of the present-day slaughter of valuable bird life is foreshadowed by what is happening to-day in Hudson Bay. Fifty years ago the number of wild duck in North America was beyond computation. But man could not slay this bird fast enough to glut his blood lust. Sportsmen, professional hunters, and agents of the millinery interest smote them by the million. Such blind and wanton butchery could have but one result. Ducks are now so scarce along the west coast of Hudson Bay, where there are no moose, caribou are scarce, and the fishing is poor, that the people living there, who had always depended on the ducks they could pack away in the autumn, find it difficult to get sufficient food to carry them through the winter.

The Æsthetic and Sentimental Value of Birds.

Omitting all mention of various other material benefits which birds confer on man, I will, before concluding, notice briefly their æsthetic and sentimental values.

Bird life is the part of the creation in which nature has done more in the way of bestowing mental benefactions on man than in any other of her works. Unconsciously received, yet born of it, there is a spiritual teaching, an uplifting influence, in the study of birds which tends to make a man act more constantly from principle, which tends to give a new and a more wholesome tone to his whole life.

The companionship of birds affords a happiness as pure, perhaps, and as permanently exquisite as man in his present state of being can possibly enjoy. Never came purer joy into my life than when, rising at dawn from my couch of fern, I heard the approach of the coming day heralded by a chorus of glad bird voices. Never have I experienced emotions which have so lastingly impressed my mind as when, in the inexpressible mystery of the darkened forest, with the stars drifting over, I listened to the sublime notes of some feathered psalmist, itself in night invisible.

The world itself is but an outline sketch; it is the birds which fill in the details and complete the picture. Towered vapours of the summer firmament hang on the wall of the sky against a setting of immutable blue; the trees are motionless; the glassy waters of the lake too idle to curve and break upon the shore. Nothing speaks of life or action. Suddenly, hitherto unseen in leafy tracery, a bird rushes out and up into the air, telling the sunshine all its joy. One can almost hear the mechanism start. The world begins to live and move. What artist is there who does not know this? Even when painting either of the two most majestic scenes on the earth—the ocean or the Himalayas—he adds this stimulating power to his canvas.

To turn from the palette to the pen, what poet is there who has not been inspired by birds? From the background of my memory a thousand instances of such inspiration come leaping forth. Shelley, Coleridge, and Longfellow, to mention three only of our singers, have been each rendered immortal in virtue of the power exerted on their minds by the bird. "To a Skylark," "The Ancient Mariner," and "The Birds of Killingworth" are poems that are imperishable.

The Mexicans felt the poetry when they looked upon the humming-birds as emblems of the soul, as the Greeks regarded the butterfly, and held that the spirits of their warriors who had died in the defence of their religion were transformed into these exquisite creatures in the mansion of the sun.

Was all this beauty for no purpose but for the gratification of a passing fashion? Is man constitutionally unable to realise that in the beauty of these feathered jewels there is a value greater than the value that is entered in a ledger? Children gather flowers of the field, and, presently, their fleeting fancy sated, toss them aside to wither and die. But the seeds, the roots, remain. The daisy will bloom another year; the cowslip will stain the meadows yellow

as of yore; but these blossoms of the air will never bloom again. Once gone, they are gone for ever.

Conclusion.

Birds unquestionably are one of man's most valuable possessions, yet it is just the possession on which he sets the least value.

Wherever there are birds whose plumage is suitable for millinery, there will the cruel and rapacious agents of the feather dealers be found engaged in wasteful destruction. Wherever there are birds that are classed as "game," there hastens the market hunter to kill, so long as any saleable thing remains to be killed. Wherever there are species that have been harried by man to the brink of extinction, there will be the collector also, anxious to obtain the last lingering representatives of a race before his rival gets a chance to do so. Wherever there are birds whose eggs are valuable, there hurries the egg collector to destroy not only the embryonic life, but often the mature life as well, by shooting the bird that laid the egg for the purpose of identification. Wherever in the wild places of the earth there are birds which are considered to be "good sport," there saunters that vandal of creation, the hunter of means and leisure, to expend on the most beautiful and the most harmless works of nature his instinctive desire to kill.

It is the nature of infamies, as well as of disease whose progress is not checked, daily to grow worse; and if the present-day wasteful and depraved practice of denuding the world of one of its most valuable natural resources is not checked, there will be wrought a mischief, a universal disaster, more awful in its results than words can express.

THE PERSIAN GULF IN 1913-14.

Trade of Bushire.

As our occupation of Mesopotamia and the probability of its extension northward at no distant date is concentrating public attention more and more on the Middle East and the ports of the Gulf, the progress of the trade of Bushire is of considerable interest. The town itself is situated at the northern end of a long peninsula running parallel to the mainland and joined to it by a sandy spit, which in winter more resembles a marsh. The population of the town is estimated to be 18,000, composed chiefly of Persians and Arabs, the former of whom tend to diminish in number. The inhabitants consist almost entirely of merchants, brokers and shopkeepers, seafaring men and coolies. Most of the important merchants hold agencies for Manchester firms, while the European official and mercantile community numbers some forty persons. Bushire has neither monuments nor relics of antiquity. The narrow and tortuous passages amid the overhanging mud-houses are filthy and ill-ventilated, but a self-supporting municipal organisation is now taking shape and the sea walls were rebuilt during the year ended March, 1914, and some of the thoroughfares were lighted and a small police force instituted recently provided with uniforms, blue for the winter and khaki with red facings for the summer. The proceeds of municipal taxes are allowed to be available for local improvements, and are not appropriated by the central treasury, and if this freedom from interference by an unappreciative capital be allowed to prevail much good may be expected. There is in Bushire one school for 350 Mohammedan boys, organised on modern lines. English is taught by an Armenian educated at Calcutta, and the three upper classes spend an hour daily at the language. Other subjects taught are Persian, Arabic, arithmetic, geography, Mohammedan law and Persian history. Many of the larger Bushire firms can correspond in English; French is almost unknown. Persian is the usual medium of correspondence.

With regard to the part played by Bushire in the distribution of foreign trade, its importance lies in its situation at the terminus of the great caravan route running through the middle of Persia by way of Shiraz and Isfahan to the capital, Teheran. The prosperity of the port thus depends largely on the up-country markets, on the security of the roads, and on the available means of transport.

The Kazarun route from Bushire to Shiraz continued in use throughout the year, and though traffic was interrupted on two occasions in consequence of attacks on the gendarmerie, it was not found necessary to divert caravans to any of the alternative routes, as has from time to time been the case in the past. In January and February a strong anti-gendarmerie feeling began to manifest itself, some of the neighbouring khans were plotting against the force, and muleteers were complaining of the over-regulation of the road, and on February 26th an outbreak took place which came near destroying a considerable proportion of the gendarmerie, and from the effects of which the force will take many a long day to recover. The only Swedish officer at Kazarun was shot dead, trying to make an arrest there, whereupon the whole countryside rose and besieged the gendarmes in their barracks. On the latter being rescued, they ran amock in the town, looted indiscriminately and committed the most horrible atrocities. British firms in Bushire alone estimated their losses at Kazarun at £4,850.

As regards the volume of trade, the total imports for 1913-14 decreased by £125,953, as compared with the previous year, there being a considerable drop of 38 per cent. in the value of ordinary cotton piece goods. Specie imported

exhibited a decrease of £62,000, and the progress of the Anglo-Persian Oil Company at Mahommerah also much reduced the market for foreign kerosene. The exports also exhibit decrease, owing to the failure of the harvest.

IRISH KELP INDUSTRY.

The Twenty-second Report of the Congested Districts Board for Ireland, recently issued, gives some particulars of the Irish kelp-making industry. It appears that the rise in the price of kelp which was mentioned in the previous report has been maintained. This increase, it is stated, was necessary if the Scottish and English manufacturers of iodine and its by-products desire to procure supplies of kelp from the west of Ireland, as the price of the fused or charred seaweed known as kelp had sunk to a rate that no longer encouraged the collectors and burners of seaweed to continue to pursue one of the most laborious occupations conceivable, at which the clothes of the workers are generally soaked in sea-water or rain, or in both. The seaweed is snatched from the shore during a storm, or in some places during calm weather is torn with long rakes from the bottom of the sea where there are rocky shoals. The tearing of the seaweed from the bottom of the sea is carried out at considerable risk by crews in open boats, and a fair price is certainly due to the men and women engaged in the task. When the harvest of particular kinds of seaweed is gathered, it has to be turned and dried like hay until it is dry enough for burning in trenches dug in the ground above high-water mark. The buyers of the kelp complain, and often justly we fear, that, when the seaweed is in a molten state, sand and stones are sometimes mixed with it in order to increase its weight, as kelp is bought by the ton All real friends of the kelp-burners urge them to abandon any such method of adulteration, as the purchasers, who make a careful chemical analysis at the time of purchase, find out whether the kelp has been adulterated, and, if they find stones, gravel or sand in the clinker of burned seaweed, a lower price all round is not unnaturally fixed by them so as to protect themselves from the fraud that is uselessly attempted. A new method was tried a few years ago of burning the seaweed to ashes instead of clinker. The kelp-buyers do not, however, at most parts of the coast, wish the new method to be continued, as the ashes have to be put in bags and are more liable to injury from the weather.

AMERICAN PEARL FISHERIES.

Salt-water pearl-fishing in America has been pursued from earliest history, and while these fisheries may not be as ancient as those of Ceylon or the Persian Gulf, Columbus and his successors often found uncivilised nations of the West wearing pearls of great value. Indeed, so many pearls were found off the Venezuelan coast that early explorers gave the name of "El Gulfo de las Perlas" to the most prolific fisheries there. Nowadays Margarita Island, off the Venezuelan coast, is frequented by hundreds of boats every autumn, and the divers reaped such a harvest that the Government had to resort to special precautions to prevent the extermination of the beds. Many of the expert divers of Venezuela have engaged themselves to an Ecuadorian company which is developing pearl-fishing along the coast of that country. Near the little port of Manta the results have proved quite satisfactory, and during a recent year about £4,000 worth of pearls were shipped to European markets. Along the shores of the islands of Panama Bay there are pearl-fisheries, the exploiting of which, however, are much hampered by the heavy tides in these parts. A boy accidentally picked up an oyster a few hundred feet from the shore which yielded a pearl that brought locally £600. Later on the same pearl was sold in Paris for £2,400. It is said that, speaking generally, an ordinary fishing-boat party expects to secure several tons of shells a day, and possibly one shell in a thousand contains a pearl. The Mexican waters in which fishing takes place are from 30 to 50 ft. deep, and the expedition, which is at work for from four to six months, often costs from £2,000 to £3,000, and even if the pearls do not always pay for this outlay the mother-of-pearl, which is so highly prized for toilet articles and the like, should be of sufficient value to repay the general outfitting expenses.

It is said that pearls from American waters are to be seen in the crowns of most European rulers. One of the most valuable pearls ever obtained in Mexican fisheries was sent to Paris, and there sold to the Austrian Emperor for £2,000. On another occasion the Government of Spain presented to Napoleon III. a black Mexican pearl valued at £5,000. The combination tints of black, blue and green are quite rare, and the Mexican and Panama pearls often combine these colourings to the height of perfection. Many valuable pearls are secured by ignorant divers who, not knowing their true value, part with their finds for a mere pittance; often beautiful gems are sold for two or four pounds, only to be resold in the markets for £2,000 or £4,000.

Many of the world's most beautiful pearls have come from Venezuela, and it is said that in 1579 King Philip of Spain obtained from near Margarita Island a pearl weighing 250 carats, which was variously estimated to be worth from £8,000 to £14,000. The most perfect pearl in the world is said to be the "La Pellegrina," a rare gem preserved in the Zosima Museum in Moscow; it weighs 28 carats, is globular in form, and originally came from Indian waters. The world's largest pearl is in the Hope Collection in the Victoria and Albert Museum, which

weighs 3 oz., and has a circumference of 4½ in. According to one of the chief authorities, a pearl of the finest grade should have "a perfect skin, fine orient or delicate texture, be free from specks or flaws, and be of translucent white colour with a subdued iridescent sheen. It should be perfectly spherical, or, if not, of a symmetrical shape. White or pink pearls are the finest, owing to their delicate sheen." In China and Japan pearls are mentioned in history as early as 1,000 B.C., and nowadays a process for the artificial propagation of pearls is to be seen at a pearl farm at Argo Bay, whereby a serum is injected into the shell and, irritation being set up, the oyster is encouraged to coat the offensive foreign matter with layer after layer of calcareous deposits. A few years pass and the same oyster is fished up from the waters and his pearl-making work examined. Possibly a beautiful pearl may have been formed.

River or fresh-water pearls are found quite generally in temperate climes of the Northern Hemisphere, especially in the British isles, Saxony, Bavaria, Bohemia, Canada and in many parts of the United States. In many of the rivers of Ohio and other States mussels have been found from time to time that contained good pearls, but the general public is said to be disinclined to purchase these.

THE DEVELOPMENT OF THE TEXTILE INDUSTRIES.

The War and Production.—The limiting effects of war make themselves more noticeable, and it is probably safe to say that the total productive powers of the British textile industries have, for the time, passed the zenith. There are sections which are not too fully employed, but those who most want men cannot find them, and the joint demands of the Army and the munitions factories forbid the idea of any material total expansion of textile work. The proximity of the limits is felt otherwise than in the direct inability to secure men. Industries rely upon each other, as manufacturers have been sharply reminded by a recent rise in coal. Costs of all supplies advance either because of the shortage of men to make them or of the exceptional demand for other purposes, and upon the whole this process seems likely to continue. Until the emergency arose nobody realised how many essentials in one sort of manufacturing are indispensable to some other, or how the rival demands might clash when there was no longer unlimited room for increasing the production of any article which chanced to be wanted. Even though the pressure is borne in good part, it is unmistakably felt, and there is perhaps to be more squeezing to fit into a narrower world. Nobody escapes the practical difficulties, which are naturally more annoying to those who are faring badly in profits than to producers who are more handsomely compensated for their troubles.

The Demands upon Machines.—The limitation of consumption began with the war, during which stocks in hand in all markets have been decreasing, while machinery has been occupied largely in making goods different from those needed for normal purposes. Eventually these reserves will have to be restored to a certain level, and until that has been reached replenishments will be wanted with more than the usual urgency. A state of affairs that on the one hand restricts production and upon the other admits of some quickening of demand, is not essentially an unfavourable one for parties in a position to produce manufactured goods. There are accordingly promises of an uncommonly good time coming for those fortunate enough to own machinery. Textile machinery is, of course, dearer than it was, and all facilities for obtaining new machines have been reduced. If new building is not absolutely out of question, there still remains the inadequacy of the labour supply. Machine-makers find that such new business as reaches them is traceable in almost all cases to war work. The circumstances seem all to point to the desirability of increasing the capacity of such machines as exist, and to favour the adoption of auxiliary labour-saving devices. The habit still persists of measuring the value of time by experience gained in days before the war, although that world-shaking event can hardly do less than require the use of a new set of standards.

The Dyeware Famine.—The want of dyestuffs remains one of the serious troubles of the manufacturer of dyed goods, and, unfortunately, not a diminishing one. As dyers' colours and the high explosives, for which there is an illimitable demand, draw upon the same raw materials and reagents, the prospects of an increased supply are not too good. Consumers have to be thankful for colours at any price, and are paying something over six shillings for dyes that sold freely at fivepence or sixpence less than twelve months ago. Reports of a prospective increase in the output of anilines have only a secondary interest to men whose wants are immediate, but their number is not without significance. It was reported lately that a Bill to provide a subsidy for manufacturing aniline and alizarine colours was being introduced in Japan, where there are at least cheap labour and commercial organisations for pressing the sale of colours throughout the East where the German companies have had a profitable business. The efforts in England, America, France and Russia, added to the enlargement of the works in Switzerland, point to at least a considerable dispersion of an industry that has hitherto been remarkably concentrated. Without anticipating events too far, it may be noted that the years immediately following the Franco-Prussian War were those in which the German colour trade found its feet. The Continental war next following has prompted more or less every nation to undo the concentration of the colour supply. In a view of the case presented in a German journal the textile

industries of the new colour-making countries are destined to suffer for their obligations towards the new colour works. Even so, the fate marked out for them is not harder than that allotted by the writer to those Germans who have to provide a home market for colour by manufacturing inland the dyed goods formerly made abroad. As colour represents at most 5 per cent. of the value of the dyed commodity the case can be summed up in a homely illustration. On our side the dog would have to wag a weighted tail, and on the German side the tail would have to swing a burdened dog.

Troubles of Marketing. - The notion that American industry was bound to profit from the disabilities laid upon manufacturers in the Old World readily gained acceptance as an axiom. The president of the American Cotton Manufacturers' Association has, however, had to admit to a disappointment. Instead of running night and day, as expected, a good many American cotton-mills are actually upon short time, and few of them are doing what can be called a profitable business. It may thus be supposed that, broadly, the same influences have operated in the United States as in our own country, for the description applies about equally to either. The effects in America have been ascribed to other causes—to defects of the American export distribution system, to ignorance of foreign wants, to faults in the American tariff, to the want of an American mercantile marine, and to the absence of general advertising devices. Improvement in some or any of these respects might have assisted Americans to make the most of their own opportunities; but it is not apparent that they would have relieved customers of their disadvantages, and the disabilities of buyers are matters deserving of being taken into serious account in any consideration of the question. Those who have been led to form an opposite impression may be astonished at the confession made by a manufacturer described as one of the best-posted in America. The confession is that "we" (meaning American cotton manufacturers and their commercial agents) "are undoubtedly the poorest merchants in the known world." How much of this self-abasement is due to chagrin over a failure to obtain business not readily obtainable by anybody, and how much to long-established conviction, does not immediately appear. It would not be easy to apportion the causes of English success in the cotton trade as between the manufacturing and the merchanting branches. The two are distinct, and there is no denying that much is due to the division of functions, the activities of merchants, and the facilities afforded by our banks. The Americans are not, however, advised to follow the Lancashire system of trading. The Assistant Professor of Marketing in the Harvard School of Business Administration recommended each manufacturer to make his own studies of the foreign field for himself. The example of a playing-card manufacturer was commended—a manufacturer who engages men to play cards with all classes of people in specific countries for weeks and months, learning the favourite games of the people, and their preferences in designs for the back of the cards, with their wish in the matter of "body" and "slip." It does not reflect upon the enterprise of those who utilise these methods to point out that the measures must come in somewhat expensive when the manufacturers in point can be numbered in thousands. Free from the responsibilities of the machine-owner, the merchant is able to devote more attention to the fluctuations of foreign fancy than the manufacturer can reasonably be expected to spare, and the merchant has the incidental facility of going further to meet incipient changes, for he can offer a wider variety of goods than any one manufacturer can economically produce.

Textile Research Work.—The devotion of new public funds to the furtherance of industrial research should stimulate manufacturers to consider the points upon which they most need illumination. Evidently it is for them to determine their needs and to press for their favourable consideration. A disposition has been noted to connect research exclusively with chemistry, and to conclude hastily that the money cannot be better applied than to the problems surrounding dyewares. Some separate provision has been made for those last, and it seems desirable to inquire whether there is nothing in the line rather of physics than chemistry, and of textile materials rather than of chemical products, deserving of special endowment. There doubtless was a time when the devotion of funds to the study of the nature of steel seemed quite as quixotic as minute attention to the small characteristics of textile fibres may seem to-day. At present there is comparatively little to go upon in the way of practical demonstration of the utility of scientific investigation applied to textile fibres and processes, but this should not constitute a barrier. The object is the discovery of that which remains unknown, and which, if known, might lead to unrecognised consequences. The whole matter being one of the finest of fine points, it follows that there may readily be disagreement as to the work that should be undertaken first. But there is probably nobody who has not encountered the inexplicable in course of his own technical work, and a recapitulation of the things one wants to know should afford a fair basis for the guidance of investigators. Every department has its own problems, to some of which more private research has been applied than to others. To take a fairly obvious and crude example, many are concerned to know the exact effects of increasing the twist in yarns. Up to a point increase of twist gives increase of strength, and beyond that point the tensile strength diminishes. So much is established by private

experience, and it is apparent that the variation, although not uniform, conforms to certain rules which are doubtless capable of elucidation by experiments conducted upon an adequate scale. In other connections there must be relatively simple facts waiting to be liberated, to the general advantage of all concerned, and it cannot be gainsaid that more revolutionary discoveries may be lying hidden and unsuspected.

CORRESPONDENCE.

DESIGN AT THE BRITISH INDUSTRIES FAIR.

In the interesting notice of the Design Exhibition in the *Journal* of the 4th inst., you comment on the absence of the work of younger and less known men, and express regret that so few are coming forward as designers. I think this may be accounted for in the first place by the limited time given the promoters of the exhibition to make it more widely known; in the second place, by the few young men who find the vocation of design production at all attractive under the present conditions of trade. Add to these two reasons the reluctance of many designers to exhibit their work to the public, and the fact that many manufacturers are slow to sanction a show of work in which is divulged the names of those on whom they rely for their "specialities." The last is a very real difficulty with promoters of exhibitions of this kind, and it will always prevent a very attractive and "up-to-date" show from the point of view of the buyer of designs and the trade decorator, resulting in something drab and *passé*.

I am fully in agreement that British design, as compared with German and Austrian, is very easily first in more ambitious decorative pattern; this is quite evident to any who know the production of the looms and printing-mills of this country, and the very large export trade we are doing in printed fabrics and wall-papers.

Now that London has firmly established a reputation for design production—although still a long way second to Paris—I am confident it will grow in importance when better co-operation is effected between Art education and trade. Industry without profit is impossible, and design apart from industry is impossible. Let us frankly admit this, and we shall make further headway.

ARTHUR WILCOCK.

NOTES ON BOOKS.

ENGINEERING. By Gordon D. Knox. London and Edinburgh: T. C. & E. C. Jack.

This book forms part of Messrs. T. C. & E. C. Jack's "Romance of Reality" series, of which four other volumes have already appeared, dealing with "The Aeroplane," "The Man-of-War," "Modern Inventions," and "Electricity."

Mr. Knox has selected, as he says, almost at random, a page here and there from the history of engineering. He begins with canal cutting, and gives an interesting account of the construction of the Duke of Bridgewater's canals and his connection with Brindley. The story of this work, with its great and often unforeseen difficulties, such the crossing of the Sale Moor Moss, makes as fascinating reading.

From the Manchester-Liverpool Canal Mr. Knox jumps to the latest and greatest of canal works. Much has been written about the Panama Canal, and the main features of it are familiar to the general reader, but in the same number of words it would be difficult to get a better description of it than is here given.

Irrigation, waterworks, and aqueducts are the subject of the fourth chapter, which includes an account of Myddelton's enterprise in constructing the "New River" in James I.'s reign, and of the building of the Assuan dam Next we have chapters on bridges, on railway construction, tunnels, mining, ships and salvage, lighthouses, docks, harbours, telegraphy, telephony, roads and materials, and a final section on engineering in war.

Without going into technical details, Mr. Knox contrives to give a very readable account of the various works which he describes, and he certainly makes out a very good case for engineering as a romantic career. It is the kind of book which, if put into the hands of a boy of a mechanical turn of mind, should inspire him with a desire for a deeper and more serious study of the subject.

THE ENGLISH COUNTRYSIDE. By Ernest Pulbrook. London: B. T. Batsford, Ltd. 7*s*. 6*d*.

Mr. Pulbrook is one of those enthusiasts for whom the English countryside has an irresistible charm. "Prehistoric trackway, ancient village, sleepy town, the farmhouse in the hollow, the sheep-fold on the hill"—all these inspire him with the passion for rambling, nor, presumably, is he above enjoying his pot of English beer at the "Chequers" or the "George" when his day's ramble is done. The result of this enthusiasm is a chatty book in which he takes us wandering haphazard from Cornwall to Cumberland, now stopping to look at a harvest scene on the Chilterns, now pausing to study the snow on a Yorkshire moor.

But pleasant as is Mr. Pulbrook's writing, he will, perhaps, hardly find fault with us if we say that the part of his book which has given us the greatest pleasure and recalled most vividly those nooks of England in which he rejoices, is the illustrations. With one exception these are photographs; some are from the author's own camera, but the majority are from the well-known series of Messrs. F. Frith and Co. of Reigate. It would be difficult to give some of these pictures more praise

than they deserve, and the manner of their reproduction leaves nothing to be desired. On more than one occasion we have felt called upon to compliment Messrs. B. T. Batsford on their share in the books which they publish. This volume is, in its way, as good as anything they have done, and as a piece of book-making is a thoroughly artistic production of which any firm might be proud.

GENERAL NOTES.

Egret and Heron Rearing in Madagascar. - An article in the *Bulletin Économique de Madagascar* gives an account of the domestication of herons and egrets in that island, whereby it has been found possible to obtain the plumage of these birds without any of that horrible cruelty which has come to be associated with the plume hunters. In the Vohemar province egrets and herons are reared and tamed by the natives, who keep them merely as pets and without an eye to profit. They are turned out by day to seek their food in the marshes or from the ticks and parasites of the cattle, and return home to roost at night. The plumes begin to appear when the bird is about six months old, but they should not be taken until it is sixteen months, or perhaps not until it has produced its first brood. They are finest at breeding-time, and are cast after this to appear next year. They should be taken by cutting near the base, and the stumps should be removed later, when they have dried up. The time to cut them is when the young begin to leave the nest and feed themselves. The article contains information as to the treatment and feeding of the birds. There are considerable difficulties in managing them—for one thing, strange birds are apt to fight furiously with one another, even to the death—but the plumage, if in good condition, is so valuable that it might well pay to start the domestication of the birds on a considerable scale.

Indian Indigo.—The contribution of Mr Howard, the Imperial Economic Botanist, to the annual report of the Board of Scientific Advice for India, contains a ray of hope for the indigo planter. The Sirsiah experiment station was closed in 1913 because the selection work on Java indigo could not be satisfactorily conducted there, owing to the fact that the plant could not be induced to form seed. The non-success of the experiments was due to "wilt," which was also the means of reducing the area under the Java plant in Bihar from 70,000 bighas in 1910 to 15,000 bighas in 1913. The botanical section at Pusa has now,' however, discovered the cause of the "wilt," which is the product of the long continued, constantly wet condition of the soil. It seems that if Java indigo is sown for seed early in August on well drained land in good condition, the disease is avoided and good crops of well developed seed are produced in February. The indigo plants can be again cut for leaf the following monsoon. These results have been repeated, Mr. Howard says, under estate conditions, and one of the chief causes of the decline in the area under Java indigo has been removed. The success of other experiments made at Pusa leads Mr. Howard to add "that the future of the indigo industry is by no means so hopeless as is often believed."—*Statesman*.

The Onion.—The larger Spanish onions are brought from France to England by boat, and are hawked throughout our South coast towns by the boat-people. It is probable that the French supply will be needed for their own use. The smaller wild species of *Allium* have been eradicated from the dairy pastures of the Midlands by the English farmer. In the botanic garden of Oxford the European and Asiatic species may be seen, and some twenty years since the cultivation of the onion was largely improved at Banbury in Oxfordshire and at Rousham. The repute of the kinds is yet maintained, but the cultivation does not get beyond that of the market garden. In an old edition of the "Encyclopædia Britannica" it is stated that the Arabs and inhabitants of the arid parts of the East use the onion for rubbing the lips and nostrils to protect them from the sun when exposure to the day's heat is necessary. The troops employed on duty in the East may find a native custom to be worth following.

Exhibition of German Trade Catalogues. The importance attached by German manufacturers to the production of catalogues printed in the language and currency of the country to which their goods were exported is well known, and has frequently been emphasised in the reports of His Majesty's Trade Commissioners and Consular Officers. In order that British manufacturers may have an opportunity of inspecting catalogues of German origin, the Board of Trade have collected over 700 specimens, illustrating a great variety of industries, and these may be inspected at the Foreign Samples Section of the Commercial Intelligence Branch, 32, Cheapside, E.C. In a number of cases goods similar to those illustrated in the catalogues are on view in the adjoining sample rooms.

MEETINGS FOR THE ENSUING WEEK.

Monday, June 21.. Victoria Institute, Central Hall, Westminster, S.W. Annual Address by Professor E. Naville, "The Unity of Genesis."

British Architects, Royal Institute of, 9, Conduit-street, W., 8.30 p.m. Presentation of the Royal Gold Medal.

Thursday, June 24...Antiquaries, Society of, Burlington House, W., 8.30 p.m.

Friday, June 25...Physical Society, Imperial College of Science, South Kensington, S.W., 5 p.m.

Journal of the Royal Society of Arts.

No. 3,266. VOL. LXIII.

FRIDAY, JUNE 25, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

FINANCIAL STATEMENT FOR 1914-15.

The following statement is published in this week's *Journal* in accordance with Sec. 40 of the Society's By-laws:—

TREASURERS' STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR ENDING MAY 31st, 1915.

Dr.

	£	s.	d.	£	s.	d.
To Cash in hands of Messrs. Coutts & Co., May 31st, 1914				2,403	10	1
,, Subscriptions	4,383	13	0			
,, Life compositions	310	8	0			
				4,694	1	0
,, Dividends and Interest				670	11	1
,, Ground Rents				638	7	2
,, Examination Fees				3,646	10	6
,, Advertisements				377	13	9
Sales, etc:—						
Cantor Lectures	9	2	3			
Examination Programmes	49	5	10			
Fees for use of meeting-rooms	58	15	0			
Journal	108	6	7			
Leather Committee Reports	3	19	5			
				229	9	1
,, Donation to Examination Prize Fund—Clothworkers' Company				40	0	0
,, Sale of £1,400 Queensland 4 per cent. Bonds				1,113	17	0
,, Donation from Reginald Le Neve Foster for a Prize				100	0	0
				£14,213	19	8

Cr.

	£	s.	d.	£	s.	d.
By House —						
Rent, Rates, and Taxes	857	10	10			
Insurance, Gas, Coal, House expenses, and charges incidental to meetings	318	13	9			
Repairs and Alterations	36	8	1			
				1,212	12	8
,, Office:—						
Salaries and wages	2,550	8	11			
Stationery, Office Printing and Lithography	406	6	10			
Advertising	49	19	6			
Postage Stamps, Messengers' Fares, and Parcels	178	16	6			
				3,185	11	9
,, Library Bookbinding, etc				52	9	1
,, *Journal*, including Printing and Publishing				1,609	1	5
,, Advertisements (Agents and Printing)				137	13	6
,, Examinations				1,522	2	7
,, Medals:—						
Albert	20	10	0			
Society's	20	6	0			
				40	16	0
,, Owen Jones Prizes				5	17	0
,, Cobb Lectures				8	17	9
,, North London Trust				5	0	0
,, Howard Lectures				8	2	6
,, Aldred Lecture				10	0	0
,, Fothergill Lectures				30	0	0
,, Stock Prize				20	0	0
,, Juvenile Lectures				30	10	0
,, Cantor Lectures				160	3	0
,, Publication of "The History of the Society"				198	13	7
,, Sections:—						
Colonial	46	9	6			
Indian	71	4	11			
				117	14	5
,, Committees (General Expenses)				20	19	0
,, Investment of Le Neve Foster Donation in £105 11*s.* 7*d.* War Stock				100	0	0
				11,476	4	3
,, Cash on Current Account and on Deposit with Messrs. Coutts & Co., May 31st, 1915 (less cash in transit)				2,737	15	5
				£14,213	19	8

Liabilities.

	£ s. d.	£ s. d.
To Sundry Creditors	892 1 2	
,, Examiners' Fees	1,344 5 6	
,, Examination Prizes and Medals	170 0 0	
,, Sections :—Colonial and Indian	100 0 0	
,, Accumulations under Trusts	288 1 1	
		2,794 7 9
,, Excess of assets over liabilities		22,519 3 3
		£25,313 11 0

Assets.

	£ s. d. Amount of Stock, etc.	£ s. d. Worth on May 31st, 1915.	£ s. d.
By Society's Accumulated Funds invested as follows :			
Newcastle-on-Tyne 3½ per Cent. Stock	3,000 0 0	2,880 0 0	
Canada 3½ per Cent. Stock	500 0 0	418 2 6	
South Australia 4 per Cent. Stock	500 0 0	493 15 0	
N.S. Wales 3½ per Cent. Stock	530 10 1	493 8 2	
N.S. Wales 4 per Cent. Stock	500 0 0	483 15 0	
G. Indian Pen. Ry. 4 per Cent. Debenture Stock	217 0 0	201 16 2	
Queensland 4 per Cent. Stock	100 0 0	98 17 6	
Natal 4 per Cent. Stock	500 0 0	480 12 6	
Ground-rents (amount invested)	10,496 2 9	10,496 2 9	
Metropolitan Water Board B. Stock	321 15 9	239 11 8	
New River Co. shares	6 0 0	6 0 0	
India 3½ per Cent. Stock	3,408 14 6	2,761 1 4	
	20,080 3 1		19,053 5 7
,, Subscriptions of the year uncollected		678 0 0	
,, Arrears, estimated as recoverable		273 0 0	
			951 0 0
,, Property of the Society (Books, Pictures, etc.)			2,000 0 0
,, Advertisements due			171 10 0
,, Cash on Current Account and on Deposit with Messrs. Coutts & Co., May 31st, 1915 (less cash in transit)			2,737 15 5
,, Do. on Deposit (against Interest on Trusts)			400 0 0
			£25,313 11 0

Funds held in Trust by the Society.

	£ s. d.	
Dr. Swiney's Bequest	£1,477 10 0	Ground-rents, chargeable with a sum of £200 once in five years.
John Stock Trust	100 0 0	Consols, chargeable with the Award of a Medal.
Benjamin Shaw Trust for Industrial Hygiene	133 6 8	,, ,, ,, of Interest as a Money Prize
North London Exhibition Trust	192 2 1	,, ,, ,, ,,
Fothergill Trust	388 1 4	,, ,, ,, of a Medal.
J. Murray and others, in aid of a Building Fund	75 14 4	,, £54 18s. 0d. and India 3½ per Cent. Stock £20 16s 4d
Subscriptions to an Endowment Fund	562 2 2	,,
Dr. Aldred's Bequest	220 2 3	,, chargeable with the Award of a Prize.
Thomas Howard's Bequest	571 0 0	Metropolitan Railway 3½ per Cent. Preference Stock, chargeable with the Award of a Prize.
Dr. Cantor's Bequest	648 19 7	Bombay and Baroda Railway Guaranteed 3 per Cent. Stock } Interest applied to the Cantor Lectures.
	3,273 16 6	India 3 per Cent. Stock
	2,695 11 3	Ground-rents
Owen Jones Memorial Trust	522 3 2	India 3 per Cent. Stock, chargeable with the Award of Prizes to Art Students.
Mulready Trust	105 16 0	South Australia 4 per Cent. Stock, the Interest to be applied to keeping Monument in repair and occasional Prizes to Art Students.
Alfred Davis's Bequest	1,953 0 0	Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock. Interest at the disposal of the Council for promoting the objects of the Society.
Francis Cobb Fund	255 14 1	New South Wales 3½ per Cent. Stock.
Le Neve Foster Prize	105 11 7	War Stock, chargeable with the Award of a Prize.
Amount to cover accumulated Interest on Trust Funds	400 0 0	On deposit with Messrs. Coutts & Co.
	£16,680 11 0	

TOTAL OF INVESTMENTS, ETC. (FACE VALUE), STANDING IN THE NAME OF THE SOCIETY (INCLUDING SOCIETY'S ACCUMULATED FUNDS AND TRUSTS AS ABOVE).

	£	s.	d.
Ground-rents (amount of cash invested)	£17,639	4	0
Consols	1,650	12	6
Metropolitan Railway 3½ per Cent. Preference Stock	571	0	0
Bombay and Baroda Railway Guaranteed 3 per Cent. Stock	648	19	7
India 3 per Cent. Stock	3,795	19	8
India 3½ per Cent. Stock	3,429	10	10
Canada 3½ per Cent. Stock	510	0	0
South Australia 4 per Cent. Stock	605	16	0
New South Wales 3½ per Cent. Stock	786	4	2
New South Wales 4 per Cent. Stock	500	0	0
Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock	2,170	0	0
Queensland 4 per Cent. Stock	100	0	0
Natal 4 per Cent. Stock	500	0	0
Newcastle-on-Tyne 3½ per Cent. Stock	3,000	0	0
Metropolitan Water Board B. Stock	321	15	9
New River Company Shares	6	0	0
War Stock 3½ per Cent.	105	11	7
Cash on Deposit with Messrs. Coutts & Co.	400	0	0

Society's Accumulated Funds	20,080	3	1	£36,760 11 1
Trust Funds held by Society	16,680	11	0	

The Assets, represented by Stock at the Bank of England, and Securities, Cash on Deposit, and Cash balance in hands of Messrs Coutts & Co., as above set forth, have been duly verified.

WILLIAM H. DAVISON } *Treasurers.*
CARMICHAEL THOMAS }

H. T. WOOD, *Secretary.* KNOX, CROPPER & Co., *Auditors.*

Society's House, Adelphi, 23rd June, 1915.

NOTICES.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Sixty-first Annual General Meeting, for the purpose of receiving the Council's report and the Treasurers' Statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new Fellows, will be held, in accordance with the By-laws, on Wednesday, June 30th, at 4 p.m.

(By order of the Council),
HENRY TRUEMAN WOOD, *Secretary.*

SPECIAL WAR LECTURES.

The Council have arranged with Professor Vivian B. Lewes to give a short course of special lectures during the recess on "Modern Munitions of War." Three lectures will be given at 4.30 p.m. on Wednesday afternoons, July 7th, 14th, and 21st.

The first lecture will deal with "Guns and Propellants," the second with "Mines, Shells, and High Explosives," and the third with "Poison Gases and Incendiary Bombs." The course will be given under the Fothergill Trust.

The lectures will be open to all Fellows of the Society, who can admit their friends personally, or by the usual tickets. Any Fellows requiring further tickets can apply to the Secretary, who will furnish them with any number they may desire for distribution. Tickets will also be issued gratuitously to any persons interested in the subject who may apply to the Secretary.

BRITISH MALAYA.

ENGINEERING AND GENERAL TRADE POSITION AND PROSPECTS.

By GEORGE D'ALMEIDA,
Portuguese Consul in Singapore.

A region receiving considerable attention from manufacturers and commercial men prior to the outbreak of the war was Malaya, particularly that portion which is under the aegis of the British flag, and it is not a fanciful deduction that when the nations return to sanity and men are turning their swords into ploughshares, Malaya

will receive much more attention than it has done in the past. The potentialities of China are greater, for it is a large country with a huge population; but it lacks the stimulus that British officialdom has given to private enterprise in the southern Settlements and Protectorates, and has not shown the same rapid movement towards self-development. It rejoices the heart of the engineer to see the measures adopted to develop British Malaya. The dock improvements at Singapore have converted that port into a first-class *entrepôt* as well as a naval base, and its position on the ocean highway between Europe and China ensures to it permanency and further development. Already an important terminus of the Malayan railway system, its harbour facilities will be enhanced when the bridge is constructed across the Straits of Johore. At Penang and Port Swettenham improvements are in progress, all making for the rapid transit of goods inward and outward, and the transhipment of cargo from local vessels to the ocean leviathans that make these places ports of call. In the interior the administration of the Federated Malay States has made improvements of incalculable value for the future of the country. The railway system compares favourably with any in the world, and is being extended to open up new areas throughout the whole of the Peninsula. The road system has won the highest encomiums, the best proof of their quality and condition, perhaps, being the steady increase in the import of motor-cars and vehicles. Public buildings and public works of every description tend to make life in the interior more attractive to native and European alike, while the expansion of the two main industries—tin-mining and rubber-planting—has added materially to the wealth of the country and the prosperity of its inhabitants. The total amount spent on public works in 1913 was £1,145,509, and in five years over four and a half millions sterling were expended. For 1914 the Federal estimates provided for an expenditure of £2,839,809 on railways against £2,168,966 in 1913.

Great Expansion of Trade.

In 1913 the Federated Malay States absorbed machinery to the value of £340,113, and railway and tramway materials valued at £324,882. In the case of machinery, the increase over the value for 1912 was £112,200, while in the case of railway and tramway materials there was an increase of £233,248. In four years the value of the trade of the Malay States almost doubled itself, the aggregate for 1913 being £27,425,843, against £14,287,936 in 1909. The increase in the import of manufactured articles was nearly 40 per cent. over 1912, the increase under this head accounting for over 75 per cent. of the total increase in imports.

Prospects for Machinery.

It is not to be wondered at that the prospects of machinery are very good, when consideration is given to the necessities of the new rubber plantation factories, the growing use of machinery in mining, and the spread generally in the use of mechanical appliances wherever they can compete successfully against the cheap native labour. For instance, the total horse-power of steam, gas, oil, hydraulic, and electrical plant employed in mining in 1913 was estimated at 25,756, compared with 23,188 in 1912. The following statistics from the Federated Malay States should have a special interest to our readers, as they show the value of some of the principal manufactured articles imported and the increase in round figures over 1912:—

	Value.	Increase
Ironware	£363,517	£149,100
Machinery	340,113	112,200
Railway and tramway materials	324,882	233,200
Cycles, motor-cars, and accessories	237,610	52,970
Cement	91,661	35,470
Steel	68,108	49,930
Telegraph and telephone materials	67,753	42,460
Tools, instruments and implements	59,974	17,200
Corrugated iron	57,877	25,300
Gas and electric lighting materials	34,375	10,090

There are many branches of trade where British manufacturers could improve their position in Malaya at the expense of some of our pre-war competitors, but few in which those enemy countries hold the superiority in the aggregate amount of trade done. Most of these, however, lie outside the scope of this article. The moral that might be drawn from an investigation of the official statistics issued by the Straits Settlements Government is that both Germany and Austria-Hungary have been represented in Malaya by energetic and far-

seeing agents, who have missed no opportunity of securing a footing and fostering and developing whatever business connection they succeeded in establishing. An idea of the relative positions of the trade of the United Kingdom and Germany in Malaya may be gathered from the following statistics taken almost at random:—

	1912.	1913.
Ironware (excluding Cooking Utensils, which come chiefly from Austria-Hungary).		
United Kingdom	£198,583	£269,782
Germany	16,895	20,883
Machinery—Electrical.		
United Kingdom	32,160	58,415
Germany	9,109	9,474
Machinery—Miscellaneous.		
United Kingdom	81,753	127,763
Germany	6,262	8,068
Cycles, Motor-cars, and Accessories.		
United Kingdom	143,935	153,756
Germany	11,125	4,831
Tools, Instruments, and Implements.		
United Kingdom	46,123	95,163
Germany	3,381	4,590

The railway and telephone and telegraph materials imported by the Government come almost exclusively from England. Statistics, though perhaps less attractive, are more satisfying than rhetoric to the business man, and if this short article has convinced our readers of the growing importance of British Malaya as a field for articles of purely British manufacture, its object will have been accomplished. Recent years have seen great changes in the Malay Peninsula. Greater changes are unquestionably in store, for the way is being prepared by the engineer for the development of this tropical Protectorate as one of the richest portions of the British Empire. Manifestly, it remains with the manufacturers and the man of commerce (backed up at all times by the press of the entire country) to ensure that British trade and commerce shall hold supreme sway in this region.

PROSPECTING FOR OIL AND GAS IN NORTH AMERICA.

By Chas. N. Gould.

In the early history of the petroleum and natural gas industry in North America there was very little done in the way of scientific investigation as to the most likely places at which to drill for these products. For many years those engaged in the oil industry had no knowledge of any relationship between the structure of the rocks and the accumulation of oil and gas. Some twenty years ago, however, geologists began studying the structure of the oil-fields, with the idea of finding out whether it might be possible to determine, in advance of drilling, where oil was most likely to occur. During the past twenty years many scientists, both in Europe and America, have studied this problem, until at the present time petroleum geology is a recognised branch of the science of geology, and the subject is taught in many of the larger universities.

The geologist's methods of work are not always understood, but they are perfectly plain and simple. They include, chiefly, good eyesight, good judgment, and years of experience. In attempting to outline these methods, and to show how the geologist goes about his work, I must first sketch very briefly the conditions under which oil and gas are found.

Long experience in many lands has shown that, in order that oil and gas should occur in paying quantities in any particular region, at least four things are necessary: a source of supply, a reservoir rock, a cap rock, and some form of structure which will hold the oil.

Whatever be the origin of oil or gas (and no one knows to a certainty how these substances have been formed), there must be some source of supply, some rock in which the oil and gas have originated. Experience has shown that the source of supply is usually a ledge of limestone. Many of the largest oil-fields in the world obtain their supply either directly from heavy limestones, or within a short distance above such formations.

A reservoir rock is also necessary in order to contain the oil. In the oil-driller's parlance this reservoir rock is called an "oil sand," because it is usually a porous sandstone, which has been filled with oil. In some cases, however, the reservoir rock is a limestone, as, for instance, the Trenton limestone of Ohio and Indiana, and the Tamasopa limestone of Mexico. The Wheeler "sand," of the noted Cushing field of Oklahoma, is a limestone. In many pools of the mid-Continent field, oil and gas have been found in or near the top of the "Mississippi lime."

A cap rock is a third essential, for there must be some substance to hold the oil and gas down and prevent their escaping. This cap rock is sometimes a hard, brittle limestone, or dolomite, as, for instance, the dolomite above the oil sand at Beaumont. Usually, however, it is a soft, fine-grained clay or shale impervious to liquids, which prevents these substances from escaping.

The fourth essential, and the one in which the oil geologist is particularly concerned, is some form of structure which will cause the oil and gas to accumulate in a certain region. Oil and gas are volatile substances and tend to rise in the rocks and to escape to the surface. If there is any way by which they can pass upward through the rocks, either along a bedding-plane or along a crevice or fault, they will do so, and will soon be dissipated into the air. If they cannot escape to the surface they will at least find their way to the highest point of the rocks in which they are contained, and will there accumulate.

Geologists, then, in prospecting for new oil and gas fields, look for high places in the rocks. The name given to an arch or upfold in the rocks is "anticline." An anticline is a place where the rocks have been folded up in an arch something like the waves of the sea. The corresponding downfold or trough is called a "syncline." An anticline may be of almost any length or width. A short oval-shaped anticline is usually known as a dome.

An anticline is not necessary for the accumulation of oil and gas, for any form of geological structure which will cause a high place in the rocks may form a suitable reservoir to hold these substances. In the California fields, and many other parts of the world, oil and gas are found alongside fault lines, at places where rocks have slipped up on one side and down on the other. In Mexico oil accumulates at places where the rocks have been raised by intrusions of basalt. On the gulf coastal plains of Texas and Louisiana, the oil occurs under what the geologist knows as "salt domes," places where the rocks have been raised up something like a great blister on the surface.

The form of structure is not essential, but the thing necessary is that at some places the rocks must have been elevated higher than at surrounding points. The oil and gas will then flow to the highest point of the uplift, where they may be reached with the drill.

What the geologist tries to do then is to locate the high points in the rocks, and to keep the oil-man from drilling on the low places, knowing that if he does so he will probably get nothing but salt water.

For many years geology was not in good repute among the oil-men. Twenty-five years ago they had never heard of it. Ten years ago there were not a dozen active professional oil geologists in the United States, and even to-day there are many of the old-time oil-men who learned the business before oil geology was invented, and have no use whatever for geologists. Within the last three years, however, there has been a marked change of public opinion on the subject among oil-men. The words anticline, syncline, arch, dome, dip, strike, fault and axis, all good geological terms, have become part of the vocabulary of the oil-man.

All the larger oil companies now employ geologists and have a geological department, just as they have a leasing or operating department. The methods pursued by these larger companies in locating new territory are something as follows: At least five preliminary steps are taken before any drilling whatever is done. First, reconnaissance; second, leasing; third, surveying; fourth, preparing a map; and, fifth, locating the wells. Whenever one of the larger oil companies desires to open up an untried field, the first step will be to send a corps of geologists to scout out the region. Sometimes these men are on the regular staff of the company, sometimes they are professional men who are employed for this particular work alone.

This first scouting is known as a reconnaissance. The geologist travels across the country, on foot or on horseback, sometimes in a buggy, or it may be in an automobile, carrying with him his aneroid barometer and hand-level. With these instruments he takes careful observations on the outcrops of all the ledges he can find, comparing the dip, strike, and elevation of the various formations, in the endeavour to locate what, to his mind, may be an anticline or a dome. This work is often done rather rapidly, and he can frequently cover several square miles in a single day. He may spend weeks or months in a region without finding any indications that look good.

The second step consists in leasing the land. If, as the result of scouting, the geologist is able to find a locality that shows sufficient evidence of containing an anticline to justify spending more money, he so reports to the company. The lease-men are then sent into the field, and they secure, on as favourable terms as possible, as much property as may be in the area which the geologist has recommended.

The third step consists in surveying the area and running exact levels on it. Men with surveying instruments, known as alidades, go into the region, and often spend several weeks in tracing out the various formations and plotting them on field maps. This work is done slowly and carefully, and the surveyor may often spend several days on a single square mile.

The fourth step consists in preparing the map. The surveyor goes into the office and transfers to a tracing the results of his field work, showing the outcrops and elevations of the various ledges of rock on the area examined. The object of this work is to attempt to locate, as nearly as possible, the exact axis or high point of the anticline.

This preliminary work having been done, the next step is to locate the wells. The head geologist will go carefully over the map with the manager of the company, and they together will select the most favourable site at which to drill the first well. Usually this will be very near the high point or axis of the anticline. The experience has been that, by drilling at this high point, one will be most likely to encounter gas. If gas is found in the first well on the axis, the next one will be drilled down the slope of the anticline several hundred feet away from the axis, with the hope of finding oil. In some cases it is necessary to drill three or four wells before oil is finally encountered.

The question is asked, What percentage of wells so located are successful? There are no absolute data in the matter, and for that reason the question cannot be answered accurately. The best estimates available, however, would indicate that of the wells located without geological investigation not more than five per cent. are successful, while of the wells located by geologists as the result of

careful reconnaissance and alidade work, about 65 per cent. yield fine oil or gas. Not all of these, however, find these products in paying quantities, because there are certain things which neither the geologist nor any other man can tell from the surface.

For instance, the geologist cannot be absolutely sure that reservoir sands, capable of storing oil, will be found in drilling, neither can he be sure that these sands, if found, will produce oil or gas. All that he can do is to attempt to keep the oil-man away from the improbable or impossible places, and give him a fair chance for getting back his money. In other words, there is always a risk to be taken in drilling for oil, and it is the work of the geologist to minimise the risk.

ELEPHANT CATCHING: THE PIT METHOD.

It is rather a puzzle to the general public how such a huge animal as the elephant is caught in a pit. The questions arise: How is he got out of it? How does he escape getting hurt? When out of the pit, how is he tied up, etc.? It is with the object of explaining how elephants are caught and trained that this sketch is written. In Mysore, and in other places where there are large herds of elephants and where the configuration of the country permits it, elephants are captured according to the kheddah system. In the Native State of Travancore the kheddah system was once tried in a small way and abandoned as being too expensive and difficult, as the nature of the undulating country is not suited to successful driving, without which the capture in a kheddah enclosure is more or less unprofitable. The pit system obtains in Travancore, and if the divisional forest officer is keenly interested in animals, and exercises careful supervision, this method of catching the elephant is not only successful, but does not harm the animals. The least carelessness in the arrangements often results in an elephant breaking his neck or otherwise injuring himself badly. The hot weather is the elephant-catching season, for elephants leave the higher ranges of the hills and come down to the rivers, the sides of which they haunt for the luxury of bathing, of which they are very fond. After the monsoon is well over, the vegetation affords succulent nourishment, and the *Eta* reed (*Beesha Travancorica*), (*Beesha Rheedii*), the bastard sago palm (*Caryota urens*), the bamboo, and other forest growth which elephants delight in, are in vigorous edible condition, and furnish abundant food.

A little experience tells the forest officer where the animals most do congregate, and the pits, three in a bunch, leach-bite fashion, are placed adjacent to the paths which elephants make for themselves, and which they follow invariably year after year. As little disturbance as possible is made in digging the pits, which are of one uniform dimension more or less. Some officers make them a foot or two deeper, some a foot or two less in diameter than others, but the pits are so constructed as to receive a full-grown elephant. The usual dimensions are 12 ft. deep by, say, 10 ft. to 12 ft. in diameter, gradually, very gradually, narrowing down to the bottom. The earth from the pits is carried and deposited not far away—and elephants love to throw loose earth over their bodies to keep off flies—and a very light framework of plaited split reeds is placed over the pits, over which are thrown leaves, a light layer of earth, and again dry leaves, etc., till the most practised eye is unable to tell the difference between the soil over the pits and that of the surrounding ground. Before this is done, however, the bottom of the pit, to quite one-third, is filled loosely with leaves, shrubs, and ferns to break the fall of the heavy brute. Fifty or sixty pits, new and old, are thus prepared in a range, and watchers are appointed, whose duty it is to sneak about the place and report immediately the fact of an elephant falling into a pit. All preparations have, of course, to be made safely to house captured elephants in what is fitly termed a cage. This is constructed of roughly-squared teak, or thembavu logs—teak for preference—as uprights, with solid crossbars connecting them. Uprights of the same kind divide the partitions, generally six, in each cage, with movable bars, which, when drawn, allow of the elephants being moved from one partition to another and also give them entry. The roof is lofty and is covered with a thatch of cocoanut leaves, and the floor is paved with teak planks firmly fixed and well drained.

As soon as the falling of an elephant into a pit is reported, the special officer appointed for the purpose hastens to the scene, and with him go a number of axemen, coolies with ropes and cables, and a couple of mahouts on two big and strong decoy elephants. On arrival some small trees are cut down and their trunks are laid across the mouth of the pit, and an estimate is formed of the age of the animal captured. If above forty years of age he is liberated, as it is difficult to train him. If under that age the animal is allowed to stay a day or two in the pit, and is fed very scantily, and on putting up his trunk through the interstices of the logs water is poured down, which the animal sucks down with his trunk and pours down his throat. When the animal is more quiet and does not fear the near approach of man—elephants are very sagacious and quickly recognise that no harm is intended them—a few of the logs over the pit are drawn away, and the mahouts let slip-knots down into the pit, and secure each hind leg in a noose. The noose of a small rope gives way to the noose of a cable, and the two cables are tied to trees near the pit. The whole of the cross logs are then removed, the decoy elephants are brought near the pit, and earth and brushwood are thrown into the pit, which, as they increase in height, permits of the elephant gradually

approaching the surface. On rising to the ground above, the decoy elephants close in and hem in their wild companion, and with their assistance a strong rope is quickly passed round the elephant's neck while the leg cables are tightened by a lot of coolies. The wild creature struggles at first, but the decoys do not spare him and punish and show him his limitations, and after a while the captive submits and is hauled along by his companions, any sudden effort being checked by the coolies hanging on to his leg ropes and the decoys.

It is extraordinary how soon the newly-captured creature understands that if he goes quietly along all will be well with him, and as the cage is not far off he is soon taken to the sliding bars, which are withdrawn, and he is finally shoved into his partition with a last butt from the decoy. The partition is so built as not to give the elephant room enough for a charge, though there is ample room for him to turn round and move about comfortably. The animal at first makes a rush or two, and only hurts himself, while the coolies outside shout and try to make him desist. After a little experience of this kind he becomes quiet, and is always ready to grasp at a bit of succulent food. There are wooden troughs in the partitions filled with water. Of course, as soon as the elephant is about to enter the cage the leg cables and neck ropes are removed. These ropes often cause abrasions difficult to heal, as remedies cannot be applied without danger to the mahout. Big syringes with carbolic lotion and medicated oil are used, and help to keep the wound healthy till the mahout is able to venture into the cage. I have known young elephants who became amenable to the mahout's attentions after twelve or fifteen days, while others remained recalcitrant for a month or forty-five days. There is a type of elephant with broad intelligent head formation which soon submits to discipline. A narrow build of head denotes a stubborn unintelligent brute that long resists the mahout.

After a month or two the elephant is taken out of the cage, and in six months' time he learns the words of command and is dragging timber, lies down in the river to be scrubbed and bathed, or takes a coconut from his Divisional Officer by opening his mouth, and then raises his trunk and trumpets a salaam like any old stager. It is exciting work, and I once had about ten elephants newly caught in the cage together, with a cow elephant which gave birth prematurely to a calf. The little one was too small to reach his mother, and was fed with cow's milk, but did not survive long.—"*A.P.S.*" *in the Madras Weekly Mail.*

BRITISH EAST AFRICA PRODUCE.

Some interesting details regarding the produce of the East Africa Protectorate are contained in the annual report by Mr. F. W. Major, the Chief of Customs of the Protectorate, dealing with the financial year ended March 31st, 1914.

During the year under report the revenue from duties on domestic exports amounted to £15,956, of which hides and skins yielded £13,350; ivory, £1,300; and rubber, £400. The total shows an improvement of £3,000 over the previous year's collection.

The total value of the exports of domestic produce from British East Africa amounted to £443,624, showing an increase of £22,540, or 5 per cent. over the previous year. Of this total £265,904, or 60 per cent., was due to two items—viz., hides and skins, £147,474; and grain, £118,430. Next in order of importance were copra, £35,587; coffee, £18,502; fibre, £16,608; live animals, rubber (wild and plantation), wool, ivory, and potatoes.

Hides and Skins.—The trade in hides and skins is one which has held an important place in East African commerce for the last four years. In that period the value of the exports has risen from £62,258 to £147,474, the increase in 1913–14 over the previous year being £59,801, or 68 per cent. High prices prevailed during the year under report, and in the local market there were ready buyers. The largest purchaser of hides was the United Kingdom, which bought 13,363 cwt., valued at £62,884. The chief customer for skins was the United States, which purchased 4,953 cwt., valued at £17,724, the next best customer being France.

Grain and Oil Seeds.—The second largest item of export is under the head of grain and oil seeds. There was a falling-off in this trade during the year of 61,462 cwt. in quantity and £28,959 in value. As British East Africa is distinctly a grain-producing country, and as rapid strides were being made in the production of maize for export, the decline in this trade proved a great disappointment, the falling-off being due to smaller shipments of almost every item of native produce. It is hoped, however, that the deficit will be met before long by an increase in the output from European farms.

Copra.—The exports of copra (31,725 cwt.) failed to reach the high level of quantity of 1910–11, but a substantial rise in the average price has increased the value to a figure not hitherto recorded. The figures for the past four years show that the exportable surplus has remained stationary, in spite of new areas coming into bearing. This points to growing local consumption. Copra is largely used in the production of vegetable butter, the manufacture of which, it is reasonable to expect, will increase. France, as usual, took the bulk of the copra exported.

Coffee.—There was a highly satisfactory increase in the export of coffee—viz., from 2,469 cwt., valued at £7,431, to 5,501 cwt., valued at £18,502. The figures show an increase of 130 per cent. in quantity and 149 per cent. in value. The United Kingdom was easily the chief buyer of East African coffee, taking

4,190 cwts. The quality of coffee grown in British East Africa is increasing in favour in European markets, and the price obtained places locally-grown coffee among the best produced in any part of the world. The industry should prosper under ordinary conditions, but the lack of labour and the presence of leaf fungus cause a certain amount of anxiety to settlers.

Fibre.—Exports of fibre have increased from 11,848 cwt., valued at £8,150, in 1912-13, to 28,478 cwt., valued at £16,608, in 1913-14. The fibre industry was entirely initiated by European settlers. Preliminary trying difficulties have been most successfully met, and it has at last been brought to a stage which leaves no doubt as to its early future prominence in the export trade of the Protectorate.

Rubber.—Shipments of rubber amounted to 1,165 cwt., of a value of £10,532. As compared with the preceding year, the quantity receded from 1,528 cwt. to 1,165 cwt., which figure includes 687 cwt. of plantation rubber. The net export of wild rubber was, therefore, 478 cwt. only, the lowest figure on record.

Wool.—The exports of wool increased from 1,689 cwt., valued at £7,908, in 1912-13, to 2,082 cwt., valued at £9,718, in 1913-14; 2,039 cwt. were consigned to the United Kingdom. The prices realised at the London Wool Exchange sale were satisfactory, and compare very favourably with those realised for wool from other parts of the world.

Ivory.—Up to the year 1903 ivory was the staple export from the country, but it has now dwindled down to a mere trifle. Ivory shipments during the year amounted to 132 cwt., valued at £8,764, as compared with 678 cwt., valued at £24,039, a decade ago.

Bark.—Shipments of mangrove bark amounted to 8,062 tons, as against 6,774 tons in the preceding year, thus showing an increase of 1,288 tons, or about 19 per cent. The value has risen from £6,433 to £8,062.

Germany bought 5,168 tons, followed by the United Kingdom with 1,500 tons; and France, with 1,370 tons. Wattle bark exported during the year amounted to 202 tons, valued at £1,917; this is an improvement of 151 tons, valued at £1,408. One hundred and twenty-one tons were shipped to Germany, and 80 tons to the United Kingdom. The Chief of Customs is informed that over 10,000 acres of land have been planted with wattle.

Cotton.—Contrary to expectations, cotton exports receded from 2,636 cwt. to 1,204 cwt. during the year under review. The cause was unfavourable climatic conditions. As usual, the United Kingdom was the largest buyer of British East Africa cotton, and received 1,117 cwt. The growing of cotton has not proved so successful in the East Africa Protectorate as in Uganda, but strenuous efforts are now being made on the banks of the Juba River to improve matters by means of irrigation.

New Products.—Noteworthy new features were the shipments of 14 cwt. of mica, valued at £219; 21 cwt. of raw silk, valued at £60; and 9 gallons of lemon-grass oil, valued at £2, all of which were consigned to the United Kingdom. For the first time there was an export of tobacco, weighing 9,133 lb., valued at £154; 3,892 lb. were shipped to Italian East Africa; 2,330 lb. to Zanzibar, and a consignment of 2,630 lb. went to the United Kingdom. Tobacco culture in East Africa is in its infancy, but it is hoped that favourable results may be obtained in course of time. The Director of Agriculture is of opinion that there is a future for this industry in certain parts of the country yet undeveloped.

Miscellaneous.—Items of export, such as beeswax, carbonate of soda, coconuts, gum copal, horns, ostrich feathers, hippo teeth, wood, etc., amount to £30,015, showing a total increase of £2,938 over the previous year. Others, such as chillies, ghee, oil-cake, cotton-seed, fine wood, cowries and other shells, give a total export of £7,188, as against £14,727 in the previous year. These increases and decreases are of minor importance, and may be attributed to fluctuations in trade.

OIL TANK-SHIPS.

In the course of a paper recently read before the Institution of Petroleum Technologists, Mr. H. Barringer gave some interesting details of the evolution of the oil tank-ship. Although there is no written history of the earliest bulk oil-carrier, the Chinese Newchwang junk, originally built for the carriage of water in bulk, and afterwards used for oil, must be amongst the earliest examples of this class of vessel. The Chinese junk was provided with an expansion-trunk, the object of this, as in the modern steamer, being to allow for expansion of oil by rise of temperature, and also to keep the main hold always full, the wash of oil from the movement of the vessel being confined to a limited space about a third of the beam.

At the same time there is a record that special instructions were issued as to the carriage of oil up the Volga about the year 1723, and in 1754 the Persians collected oil on Holy Island (near Baku) and conveyed it in sailing vessels, evidently in bulk, as it is mentioned that the sea was sometimes covered with oil for leagues, owing to the leaky state of the vessels. It is curious to note that in the early days wooden barges were employed on the Volga to carry oil in bulk direct to the skin of the vessel, but great difficulty was experienced in keeping these tight, and considerable losses from leakage were experienced. An interesting method, adopted to reduce this loss, consisted in loading the barges when full of oil with a deck-load of stones. This gave the barge a greater draught, and thereby

caused the pressure of water outside to be greater than the pressure of oil inside, the balance of pressure being in favour of water entering the barge, instead of oil leaking out, and as the decks were kept low and the hatches were made oil-tight, this did not allow much water to enter.

Although these earlier examples of bulk-oil carriage are mentioned, it was in 1875 that the first organised attempt to transport petroleum in bulk without the use of tanks was made by Nobel on the Caspian: he appears to have loaded a wooden barge with residuum, and despatched it from Baku to Astrakhan. The venture was successful, the leakage being much less than was expected, and the saving in time of loading and discharge was an immense advantage gained. But it was not until 1878 that the first steamship, the "Zoroaster," was adapted for carrying oil in bulk: at first tanks were fitted in the holds, but later on these were removed, and the oil carried to the skin of the ship.

For some years ships carrying 6,000 to 7,000 tons were favoured, but lately the tendency has been to build larger vessels; in 1912 to 1914 the average was about 9,000 to 10,000 tons, although ten vessels each of 15,000 tons capacity were built. There are now about 434 bulk-oil, ocean-going steamers afloat, representing a total tonnage of 1,637,000. Of these vessels, 192 are fitted for burning liquid fuel. In addition to these there are fifty-seven sailing ships representing 99,788 gross tons. Many of the recent ships are on the Isherwood principle of longitudinal framing.

THE COCONUT INDUSTRY.

The Canadian Department of Trade and Commerce has received from H.M. Consul-General at Rio de Janeiro a copy of a memorandum which he has prepared respecting the coconut industry, with particular reference to Brazil. The information given in the following extracts from the memorandum is of interest as indicating the many uses and the diversified nature of the products of the coconut palm, which are rapidly assuming an important place among trade products.

The Coconut Tree.

The coconut tree (*Coco Nucifera*) is indigenous to the warmer regions of both hemispheres. The tree pertains to the palm family. Opinions are divided as to the origin of the cocoa palm, some botanists holding that Asia is the original habitat thereof, other authorities (and they are in a majority) holding that the origin of the tree is South America.

In Brazil the coconut palm attains a height of 25 to 26 metres. The roots form a voluminous mass, conical in shape, composed of short, tough fibres. The bark is grey in colour. The foliage consists of fifteen to twenty digitated leaves, from 3 to 5 metres in length, and about one metre in width.

The Fruit.

When young the coconut furnishes a delicious and healthy beverage known as coconut water-milk. The pulp of the mature nut is used for various culinary purposes, and for confectionery. The exportation of fresh coconuts from Brazil is but small in amount, since the supply has heretofore been sufficient only for local demand.

Copra.

Copra is the most important product of the coconut palm; it is in world-wide demand, and it constitutes the principal source of wealth for certain countries.

The preparation of copra is very simple. The ripe nut is split open with an axe, and the contained pulp is removed by means of a knife. There exist mechanical appliances for cracking the nuts and extracting the "meat," but the axe and the knife continue to be the most practicable implements for such purpose.

The pulp, after having been removed from the shell, is set to dry, either in the sun or in specially contrived ovens. The sun-drying process occupies some three days, whereas the furnace effects its purpose in one day.

Rain and damp must be avoided, since copra while still soft becomes rapidly mildewed, and as a result loses much of its value.

Copra lends itself admirably to the manufacture of vegetable butter. In that connection the utmost cleanliness must be observed in preparing the copra, since the whiter the article the higher the price realised.

In order to obtain good quality copra the nuts selected must be fully matured. The copra yielded by young trees is much less rich than that yielded by trees from fifteen to thirty years of age. Those latter yield, on an average, from 200 to 300 grammes of copra per tree. Thus, in order to obtain one ton (metric) of copra, the product of from 5,000 to 6,000 trees is required.

Copra serves many industrial uses, such as manufacture of margarine, stearine, soap, etc.

Germany alone imported annually copra to the value of some four millions sterling. The market value of copra in Europe averages some £30 sterling per ton.

Coconut Flour.

Coconut flour is obtained from fresh copra by means similar to those adopted in the case of manioc. The copra is first ground, and afterwards placed in a pan of galvanised iron heated to a certain temperature. The flour is kept constantly stirred and sugar is gradually added, in the proportion of 10 kilogrammes of sugar to 30 kilogrammes of copra flour. The resultant product is of very agreeable flavour, and is much used for culinary purposes.

Coconut Oil.

Sun-dried copra contains 55 per cent. of oil; the furnace-dried copra contains from 60 to 65 per cent. of oil. The average yield of oil is from 4 to

6 kilogrammes per tree. Extraction of the oil is effected by means of presses, either mechanical or hand-worked.

BAGGASE.

The residue of copra, after the oil has been expressed from same, constitutes what is known as "baggase." The product in question serves principally for cattle food, and it is an excellent aliment. The average yield of baggase is from three to five kilogrammes per tree.

COIR.

The fibrous mesocarp of the coconut is known as "coir." The manufacture of coir is of simple nature and does not entail the employment of complicated or expensive apparatus.

The manufacture of coir rope is effected in the following manner: A stout knife is set in the earth, point upwards. The operator, seated, seizes the coconut in both hands and passes it four or five times longitudinally—across the point of the knife, thus stripping off the tough fibrous covering of the nut. The fibre is then strongly beaten, twisted, and cut so as to free it from foreign matter. The fibre is then ready for being made into rope, brushes, matting, and various woven materials.

One kilogramme of coir is obtained from some fourteen coconuts.

The price of coconut fibre on the London market averages some £30 sterling per ton for best quality. For inferior qualities, prices average from £10 to £20 sterling per ton.

PALM WINE (TODDY).

The spikes of the flowers of the coconut palm produce, when subjected to fermentation, a species of spirit, or wine, known as "toddy," from which in its turn excellent sugar can be extracted.

The so-called palm wine, or toddy, is made in the following manner: The floral peduncle prior to opening of the flowers that is, from five to six months after its first appearance is bound round with twine—spirally—from base to apex, in such wise as to prevent its opening. After having been well beaten with a stick, morning and evening during three or four days, with a view to stimulating the flow of sap, a cut is made in the upper part of some 5 or 6 centimetres in length. Through said cut the "wine" begins immediately to flow.

The flow of the sap continues during some four to six weeks. One floral peduncle in good condition will yield 4 to 5 litres of "wine" daily. A good palm tree will yield from 250 to 300 litres of "wine" per annum.

Excellent vinegar can be made from the palm "wine," to obtain which it is merely necessary to expose the "wine" to the action of the sun during a period of from eighteen to twenty hours.

Toddy, when distilled, yields good alcohol, the average being 25 litres of alcohol from 100 litres of sap.

The yield of alcohol per tree per annum averages some 45 litres. As before mentioned, palm "wine" can be made to yield sugar, to obtain which it is only necessary to evaporate the "wine" slowly, taking care to add a little lime for the purpose of avoiding fermentation. As soon as the "wine" has become transformed into a syrupy paste it is spread over a surface of wood or of metal, and when the evaporation is complete there remains a sugar analogous to the raw sugar obtained from the sugar cane.

COCONUT SHELL.

The shell of the coconut has no great commercial value. It is used principally for the manufacture of buttons and of fancy articles of various kinds.

In Brazil the shells are used as fuel for the furnaces employed for drying the copra. They are very useful for such purpose, since they yield much heat with but little smoke.

TRADE IN COCONUTS.

The countries which receive most of the coconuts exported from Brazil are Argentina and Uruguay. Other important purchasers of Brazilian coconuts are Chile, the United States, the United Kingdom, France, Italy, and Portugal. The States which export the most coconuts are Pernambuco, Bahia, and Rio de Janeiro. The following statement shows the quantity and value of the export of coconuts from Brazil for the years 1908 to 1912.—

EXPORT OF COCONUTS.

Years.	Quantity.	Value.
1908	141,700	£1,235
1909	213,000	1,424
1910	136,900	912
1911	172,600	1,160
1912	236,900	1,930

VALUE OF COCONUTS.

The yield of coconuts per tree varies considerably according to the nature of the land. The average yield per tree in the various parts of Brazil varies from 100 to 150 coconuts per annum. In certain exceptional cases trees have been known to yield 200, and even 300, nuts per annum. It is calculated that one hectare of land can support some 158 coconut trees.

ENGINEERING NOTES.

Hydro-electric Power in Sweden.—The famous Elfkarleby Falls, which the *Times* describes, are situated on the Dal River, some five miles from its mouth in the Bothnian Gulf. They are divided into three branches by two islets, Laxo and Flako,

and their height at low water is about 15 metres. Higher up the river there are some other falls of varying height. A reservoir is formed by dams across these three branches above the falls proper, and from this the water is taken by a canal some 350 metres long to the power-station, which is situated on the right river bank. The dams can raise the level of the water to about 21 metres above the level of the sea. The volume of the water in the Dal River in ordinary circumstances varies from 1,300 cubic metres per second at high water, to 100 cubic metres at low water. The dams produce an increase of the water volume of 50 cubic metres per second during six or eight hours out of the twenty-four, and at the power-station a mean-water volume of 200 cubic metres per second can be reckoned upon during nine months of the year. The regulation of Lake Siljan and other lakes up the river will materially increase the amount of water available. The power-station, which is designed for 200 cubic metres of water per second, will contain five turbines, each having a nominal and maximum capacity of 11,250 h.p. and 13,000 h.p. respectively. They are of the horizontal type, with four wheels, and to their axles are directly coupled three-phase generators, each with a normal and maximum capacity of 10,000 and 12,500 k.v.a. 50 periods, and 10,000-11,000 volts. The energy is to be transmitted and distributed through 20,000, 40,000, and 70,000 volt lines. At present there is in course of construction a 70,000 volt line, 154 kilometres long, to Westeras, with a branch, 50 kilometres long, running south-east to Hallsta from Dannemora. Sub-stations will be built at Dannemora, Upsala, Enkoping, and Westeras. A 40,000 volt line, 87 kilometres long, to Hofors and Stjornsund, is under consideration. A reserve steam station will be built at Westeras. The station starts under favourable conditions, as nearly the whole of its energy has already been disposed of. The money voted for the undertaking amounts altogether to over three-quarters of a million sterling.

Hydro-electric Power Scheme in Ireland.—A more ambitious undertaking has been mooted in the *Irish Industrial Journal.* It involves the combination of two power-houses utilising the waters of the Shannon and the Erne, and capital expenditure amounting to £1½ million. The drainage area of the Shannon is 6,000 square miles, and the average discharge is given as 1,320,000 cubic ft. per minute at an available head of 40 ft., equivalent to some 60,000 h.p. all the year round. It is proposed to utilise Lakes Derg, Rea, and Allen as storage reservoirs. The catchment of the Erne is almost half of that of the Shannon, but a head of 60 ft. is said to be available. Comparatively little in the way of dams would be required, although considerable dredging would be necessary below the fall, and a conduit would be required. It is proposed to establish transmission lines to Dublin, Cork, Waterford, Kilkenny, and other centres. There appears to be some difference of opinion as to the financial prospects of the scheme in its present form.

Irrigation in India and Burma.—The total area of country under irrigation in India in 1912-13 (the latest returns) was 45,574,074 acres. This total was made up as follows:—Bengal, 2,224,125 acres; Bihar and Orissa, 4,804,770 acres; Assam, 355,918 acres; United Provinces, 9,647,374 acres; Punjab, 11,302,184 acres; North-West Frontier Province, 873,615 acres; Upper Burma, 967,770 acres; Lower Burma, 123,856 acres; Central Provinces, 905,894 acres; Madras Presidency, 9,897,750 acres; Bombay Presidency, 1,003,733 acres; Sinde, 3,274,044 acres; and miscellaneous small areas, 159,041 acres. Of the total area of 45,539,074 acres dealt with, 20,256,940 acres were irrigated by canals, 6,825,189 acres by tanks, 12,350,801 acres by wells, and 6,106,144 acres by other means. The writer of these notes has been in many provinces in India, and knows what these figures and the progress made means, especially in the Punjab. The first British work in that district, to water the Baree doab, between the Chenab and the Sutlej, was undertaken in 1850 as a relief work, following the conquest of the country. By this event the Sikh warriors—who then fought against us, and who since have become the most loyal soldiers, as is proved by the present war—were deprived of their warlike occupation, and to find them employment these subsequent great works were carried out. The area irrigated is almost entirely Crown land, which was an absolute desert previously, but is now covered with luxuriant crops. The majority of the irrigated land is held by small proprietors. Several towns, one of which has about 10,000 inhabitants, have sprung up in the district, which has a railway and a network of telegraphs, the latter being chiefly used for water regulation.

The Gas Turbine.—For large powers, the turbine possesses many advantages over the reciprocating engine, such as small floor space and even turning moment, the latter feature being essential in the driving of electrical machinery, but up to the present time turbines have always been steam-driven. It is generally recognised, however, that the internal-combustion engine is more economical in its fuel consumption than the steam engine, owing to the fact that the energy realised by combustion is directly utilised in the cylinder of the engine. A considerable amount of discussion as to the possibility of running a turbine by gas has therefore taken place from time to time. Among many considerations there has been one which appeared fatal to the idea, *i.e.*, that the temperature of the resultant gases formed by the combustion of the fuel would be destructive to the blades of the turbine. Yet we learn from the *Electrician* that the experimental gas turbine is an accomplished fact. Just before the war, a machine of

1,000 h.p. was built in Germany. It is understood, however, that some difficulty was experienced in the operation of the valves, and it was not found practicable to work the whole of the explosion chambers. The turbine is worked on the impulse principle. In the ordinary internal-combustion engine the cylinder is an explosion chamber and power cylinder combined. In the impulse gas turbine the explosion chamber is separate from the power member. There are ten pear-shaped explosion chambers grouped radially round the shaft of the turbine. In each chamber there are entry valves for air and gas. The operation is similar to the existing two-cycle gas engine, and is as follows: Air is forced into each explosion chamber in turn. The gas entry valves are then opened and gas is forced in also under pressure. When liquid fuel is employed a spraying apparatus worked by compressed air on similar lines to the Diesel engine is used. When the explosion chambers are filled with the correct proportion of gas and air, the mixture is fired by electric sparks passing between the contacts placed in several parts of the chamber. On the combustion of the charge the temperature rises, the pressure following. The outlet valve in the neck of the explosion chamber is then opened and the hot gases are forced out through a conical nozzle similar to that used in De Laval and Curtis turbines. From the nozzle the cooled and expanded gases impinge on the rotor. A fan is employed at the exhaust to assist in drawing the hot gases through the rotor. When the pressure in the explosion chamber has been spent, a blast of air is forced through to perform the office of scavenging, as in the two-cycle reciprocating engine after the completion of the power stroke. In the case of the turbine, however, the time available for scavenging is longer, and the result must be more satisfactory. A fresh supply of fuel is forced into the explosion chamber and the process continues. The exhaust gases are employed to raise steam in a small boiler, the steam being used to drive the fan, air and gas pumps, and also for the producer. It is claimed that a gas turbine would occupy only one-third of the space required for a gas engine of equal power, and would be one quarter of the weight.

The Present State of Engineering in Germany.—The Copenhagen correspondent of *Electrical Engineering* writes: "It is wrong to say that the industry in Germany is disorganised. In my opinion it has never been so organised as at present, but the whole organisation has been altered to meet the war requirements. The Government has taken over practically the whole supply of brass and copper and other metals useful for war purposes. A vast number of factories are working day and night on Government orders, and, as the German Government pays tremendous prices, the firms having this sort of work do not care for any other. However, in the electrical industry there are a large number of small firms, especially down in the Thüringen neighbourhood. Most of those firms have no Government work, but they cannot supply the usual accessories because all their stocks of metals have been taken from them. Therefore, they have now to make lamp-holders, lamp-sockets, switches, and, in fact, all accessories, of brass-covered iron. With their usual technical thoroughness and cleverness they have succeeded in producing an article of first-class quality. The finished article looks exactly like brass, can be polished like brass, and, I believe, withstands moisture and other rough treatment. For a long time the Germans have been using insulated iron wires instead of copper wires."

Electrical Enterprise in India.—In a paper on electric power in India, Mr. H. R. Speyer gives a few details of the most important power schemes in that country. The largest is that of the Tata Hydro-electric Power Supply Company, whose power-house, which has just been completed at Khopoli, Bombay Presidency, will supply 30,000 h.p., and later 60,000 h.p., to the Bombay cotton-mills. The Cauvery power scheme in Mysore has now a station capacity of 16,750 h.p., and transmits power 92 miles at 35,000 volts to the Kolar goldfields. A further 5,000 h.p. is about to be installed. The Calcutta Electric Supply undertaking has a capacity of 15,000 h.p., and the Bombay Tramways and Electric Supply Company has a station of 12,000 h.p. The largest private generating station is that of the Tata Iron and Steel Works Company at Sakchi, Bengal. There are a number of electrically worked tramways in India, but at present no railway has adopted electric traction. Several schemes are, however, being considered by the Indian state-owned railways.

NOTES ON BOOKS.

Natural History of the Adélie Penguin. By Staff-Surgeon G. Murray Levick, R.N. London: British Museum (Natural History), and Longmans, Green & Co. 5s.

No bird is more delightfully human than the penguin, and no bird is more easily studied, when once you have reached his almost inaccessible habitat; for he shows but little fear of man, and suffers him, if not gladly, at least with a tolerant indifference. Staff-Surgeon Levick, who was a member of the British Antarctic ("Terra Nova") Expedition of 1910, had unrivalled opportunities of becoming acquainted with the Adélie penguins, and in this fascinating monograph he has presented a faithful and photographic picture of them which will be a thing of joy to every lover of birds.

He begins by describing their arrival at the rookery at Cape Adare. On October 13th, 1911, a solitary bird was visible; on the 15th two were walking about on the beach; on the 16th there were about a hundred, and on the 17th, "we

could see a long line of Adélies, tailing out in snake-like fashion, as far as the horizon." The mode of progression of the travellers was laborious. "First would come a string of birds toddling along, their little legs enabling them to advance only about six inches at each step; but, going at the rate of about 130 steps per minute, they covered some two-thirds of a statute mile per hour . . . Close on their heels would come another string, tobogganing on their breasts, and using their legs as propellers, the rate of progression being exactly the same as when they walked, so that the procession kept its formation as it passed over the ice. Every now and then those that walked would flop forward on to their breasts and toboggan, and those that tobogganed would as suddenly pop up on to their legs and walk."

Anxious to study the precise manner in which the penguin sets about his courting, the author singled out one particular bachelor cock who had just arrived on the scene, and carefully followed him. "Threading his way through nearly the whole length of the rookery, he avoided the tenanted knolls where the nests where, though occasionally he seemed to glance up at them in passing. Every hundred yards or so he stopped, ruffled his feathers, closed his eyes and remained so for about half a minute, when he would rouse himself and continue on his way. Evidently he was tired after his long journey and struggling against a desire to sleep.

"Arrived at length at the southern end of the rookery, he seemed to make up his mind, and boldly ascending a knoll which was well tenanted and covered with nests, walked straight up to one of these on which a hen sat. A cock stood by her side, but the newcomer either did not see him, or refused to notice him. Sticking his beak in the ground in front of the nest, then lifting his head, he made as if to place an imaginary stone in front of the hen . a most obvious piece of dumb show.

"She took not the slightest notice of him, neither did her mate, to my surprise.

"Abandoning this quest, he went straight up to another couple who were established near by, but, seeing him coming, and evidently knowing what he was after, the cock immediately flew at him, and after a sharp fight, in which he used his flippers energetically, the interloper was driven down the side of the knoll and away from the nests, when the victor returned to his hen. With the persistence of his kind, the newcomer came straight back to the nest, but weariness seemed to overcome him, for he settled himself for a doze, in which he continued until I was too cold to await further developments."

Apart from the fighting, in which the cocks indulge very freely, the whole of the mating season is an arduous time for both parents. From the moment they arrive at the rookery until the eggs have been laid, both birds fast entirely. The reason for this is probably that while nests are being built everywhere, and the unprincipled thieves are trying to steal the stones that the more industrious birds have gathered, they dare not leave their property unprotected. Sometimes this fast is continued for as much as twenty-eight days, and yet, in spite of the fact that they have undergone a long and wearisome journey, and a long period of battle and anxiety, they seemed to be but little the worse for it.

It is pleasant to learn that, besides their hardships and anxieties, the Adélie penguins can also enjoy their sports. Bathing parties are among their favourite recreations. "To watch these parties was interesting and instructive. On leaving their nests the birds made their way down to the ice-foot on to the sea-ice. Here generally they would wait about and join up with others until enough had gathered together to make a little party, which would then gaily set off for the water. They were now in the greatest possible spirits, chattering loudly and frolicking with one another from time to time, playfully chasing each other about, or indulging in a little friendly sparring with their flippers. Arrived at length at the water's edge, the same procedure was almost always gone through.

"The object of every bird in the party seemed to be to get one of the others to enter the water first, and they would crowd up to the very edge of the ice, trying by various tricks to push each other in. As a closely packed bunch of birds stood on the brink, those behind would try to rush the front rank over, who then, barely recovering themselves, would rush round to the rear and endeavour to turn the tables on the others. Occasionally one would actually get pushed in, only, by a lightning turn under water, to bound out again on to the ice, with a movement so quick as to resemble an indiarubber ball hitting the water and bouncing out again.

"Then for some time they would chase one another about, seemingly bent on having a game, but each bird intent on avoiding being first in. Sometimes this would last a few minutes only, but often for an hour or so, until suddenly one of the number started to run at full tilt along the edge of the ice, the rest following closely on his heels, until at last he took a clean header into the water. One after another the rest of the party followed him, each taking off from the spot where he had entered, and following one another so quickly as to have the appearance of a lot of shot poured out of a bottle into the water. Then for a few seconds not a ripple would be made, and a dead silence ensue, till they would all appear some twenty or thirty yards out and start rolling about and splashing in the water, cleaning themselves and making a noise that resembled a lot of boys calling out and chaffing one another. Seemingly reluctant as they had been to enter the water, when once there they evinced every sign of enjoyment, and would stay in for hours at a time."

Another game of which the birds seemed very fond was what is called by Staff-Surgeon Levick

"excursion boats." Small ice-floes were carried by the tide past the rookery at the rate of some six knots an hour. As one of these approached it would be boarded by numbers of penguins, who sometimes crowded on to it until it could hold no more. As they sailed past close to the shore they would shout remarks to other penguins who stood on the ice-edge, and these would in turn shout back at them, so that a running fire of chaff seemed to pass between those on the bank and those on the "excursion steamer." As soon as the floe reached the lower end of the rookery, the birds would suddenly plunge into the water and swim back against the stream, only to board a fresh floe for another sail. In this way some of them would spend many hours of the day.

Another remarkable feature in the conduct of the penguins is the drill which they carry out with almost military precision, before they leave the rookery for their winter quarters. The manœuvres lasted for many hours, and seemed to be carried out on the orders of some leader.

Staff-Surgeon Levick's monograph is an extremely interesting and valuable study of these delightful penguins, who are at least as human and entertaining as the birds of Aristophanes or the inhabitants of Anatole France's Penguin Island. Its value is increased by twenty-one admirable photographs depicting the birds in various characteristic occupations and poses.

VICTORIA AND ALBERT MUSEUM. REVIEW OF THE PRINCIPAL ACQUISITIONS, 1914. Illustrated. London: H.M. Stationery Office. 1s.

In spite of the war, the year 1914 has been a fortunate period for the Victoria and Albert Museum. Of course, the finest acquisition has been M. Rodin's noble gift of his own sculpture. Next, perhaps, in importance is the Studley silver-gilt bowl, presented by Mr. Harvey Hadden, which is the earliest, and probably the most interesting, piece in the department of metalwork. In addition to this, a good many valuable pieces have been acquired. The department of textiles has been enriched by a notable Turkish carpet of the sixteenth century and a Sheldon tapestry, while Sir William Ingram has presented to the collection of illustrations a selection from 5,000 original drawings made for the principal weekly illustrated papers during the last generation.

Many of the acquisitions are illustrated in the catalogue, and very excellently are the blocks reproduced. The directorate are to be congratulated on the manner in which the book is presented: it not only serves to inform the public as to the acquisitions to the museum for the period under review, but is a record of permanent interest to the connoisseur.

CHATS ON JAPANESE PRINTS. By Arthur Davison Ficke. London: T. Fisher Unwin. 5s. net.

The history of the Japanese colour print is among the romances of art. The artists belonged, as a rule, to the Popular School of Japanese Painters, and were socially of the rank of artisans. They received little or no recognition from the aristocratic school of painters or their patrons. "Even as artisans," says Mr. Edward F. Strange, "they were graded below the swordsmiths, metal-workers, and makers of lacquer. Many of them lived in extreme poverty, and occasionally they were driven to the practice of various other humble callings in order to get a living. Thus, Hokusai had at one time to take to selling calendars and red pepper in the streets; Hokkei was a fish-hawker; Kunisada kept a ferry." They looked for patronage to the lower classes, and catered for the theatres, the tea-houses, and the *Yoshiwara;* and consequently their prints were sold for a few pence in the streets.

Up to fifty years ago these works were practically unknown in Europe. Among the first European collectors were Whistler and Rossetti, who found examples in Paris about the year 1859. In 1862 much interest was aroused in Sir Rutherford Alcock's collection, which was shown at the International Exhibition of that year, and since that time the cult of the Japanese print has rapidly extended.

Mr. Ficke, who has devoted much time and study to the subject, writes an interesting history of the art, dividing it into five periods: the Primitives, the early Polychrome masters, Kiyonaga and his followers, the Decadence, and the Downfall. From considerations of convenience, all the examples with which the book is lavishly illustrated have been taken from American collections; but this restriction matters the less, as many very fine specimens have found their way to the United States.

Not the least useful chapter of the book is the last, in which Mr. Ficke writes of the collector. He gives some sound advice to the buyer of Japanese prints, suggesting the general lines that should guide him in making his selection, and adding some valuable hints about prices. The reader who has assimilated the knowledge here contained will be able to face the dealer with little fear of suffering for his temerity.

GENERAL NOTES.

TECHNICAL RECRUITS FOR THE ROYAL ENGINEERS.—A number of young men between the ages of 17½ and 19 are required to join the Royal Engineers for the purpose of training as telegraph and wireless operators. The men required are those who have attended polytechnics or technical schools throughout the country. Those joining will be required to enlist in the Royal Engineers at the usual rates of pay. They will then be sent to the General Post Office, or one of its branches, for the course of training, after which they will be attached,

according to the exigencies of the service, to the Royal Engineers or to the Royal Aircraft Corps. As the session in many of the institutions has closed, it is difficult to acquaint those who may desire to avail themselves of this opportunity. Mr. Robert Mitchell, director of education at the Polytechnic, Regent Street, W., will therefore be glad to forward full particulars to any young man wishing to join this special branch of the Army.

CUBAN SUGAR OUTPUT.—A recent issue of the *Cuba Review* gives the following figures, showing the output, in bags of 325 lb. net, of the active sugar plantations of Cuba during 1914, and the estimates for 1915, by provinces:—

Provinces.	1914.	1915.
	Bags.	Bags.
Habana	2,117,026	2,077,000
Pinar del Rio. . .	352,002	317,000
Matanzas	3,634,294	3,853,000
Santa Clara . . .	5,175,559	5,360,000
Camaguey . . .	2,062,998	1,995,000
Oriente	4,515,939	4,414,000
Total . .	17,857,818	18,016,000

GREEK MERCANTILE MARINE.—One of the most remarkable phases in the development of Greece, according to His Majesty's Consul at the Piraeus, has been the steady expansion of the Greek mercantile marine within recent years. At the end of 1903 the number of vessels comprising the merchant fleet of Greece was 210 steamers, with a combined tonnage of 202,140 tons; at the end of 1914 it was 440 steamers, with a tonnage of approximately 900,000 tons. The increase in shipping rates since the South African War has contributed largely to this expansion, and certainly has had an extraordinary influence on the economic situation of the country. According to statistics published by a local journal, 85 steamers of 219,450 gross tons were added to the Greek flag between July, 1913, and the end of December, 1914. The value of these steamers, reckoned at an average of £8 per ton gross, amounts to £1,755,600, and the total value of the Greek mercantile marine amounts to about £6,800,000. It is estimated that the savings which the Greek mercantile marine will realise in 1915, as a result of the war, will exceed £3,000,000.

INDIAN INDIGO.—At the Indigo Conference held in Delhi in February last the possibility of assisting the industry was considered from three points of view: agricultural, research, and commercial. It was generally agreed that on the agricultural side everything possible was being done by the Government, and that the outlook was distinctly promising. Valuable discoveries have been made by Mr. and Mrs. Howard, and if their recommendations be followed and an adequate supply of good seed could be secured, the plant would be less liable to wilt and the outturn would be increased. In regard to the difficult question of research, the conference considered that if indigo was to be placed on the market in excess of the present demand for cake, a chemist should be appointed who would work on the standardisation and purification of natural indigo, and on its preparation in the form most suitable to consumers. This recommendation is now being considered by the Government of India. The most important commercial question discussed was the preferential treatment of natural indigo, and the preferential treatment which might be given to synthetic indigo manufactured in England. The proposal is now under consideration. In this connection it is announced for general information that in view of the shortage of indigo, and in order to prevent the speculative withholding of stocks, His Majesty's Government have purchased supplies of natural indigo through the ordinary trade channels and in the open market.

COAL IN THE UNITED KINGDOM IN 1914.—The General Report on Mines and Quarries for 1914 shows that the output of coal from mines under the Coal Mines Act, which was 287,411,869 tons in 1913, fell to 265,643,030 tons in 1914, a decrease of 21,768,839 tons. For the period January to July the number of persons ordinarily employed at these mines was 1,133,746, an increase of 5,856 on the figures for the whole of 1913; but, owing to the heavy depletion of labour due to recruiting in the last five months of the year, the number of persons employed fell to 981,264.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 28...Geographical Society, Burlington-gardens, W., 8.30 p.m. Mr A. R. Hinks, "The Map of Europe and the Near East, compiled by the Society for the General Staff."

TUESDAY, JUNE 29...Asiatic Society, 22, Albemarle-street, W., 4 p.m. Professor P. Van Den Ven, "Byzance et les Perses à l'Époque de Justinien."

Roman Studies, Society for the Promotion of, at the Society of Antiquaries, Burlington House, W., 4 p.m. Viscount Bryce, "The Influence of Religion in the Rise and Continuance of the Roman Empire."

East India Association, Westminster Palace Hotel, S.W., 4.15 p.m. Dr. J. Pollen, "Russia and India."

WEDNESDAY, JUNE 30...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4 p.m. Annual General Meeting.

Royal Archæological Institute, at the Society of Antiquaries, Burlington House, W., 4.30 p.m. Professor G. Baldwin Brown, "Was the Anglo-Saxon an Artist?"

FRIDAY, JULY 2...Royal Historical Society, 22, Russell-square, W.C., 8.30 p.m. Professor C. H. Firth, "Military Ballads."

Journal of the Royal Society of Arts.

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FRIDAY, JULY 2, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

SPECIAL WAR LECTURES.

The Council have arranged with Professor Vivian B. Lewes to give a short course of special lectures during the recess on "Modern Munitions of War." Three lectures will be given at 4.30 p.m. on Wednesday afternoons, July 7th, 14th, and 21st.

The first lecture will deal with "Guns and Propellants," the second with "Mines, Shells, and High Explosives," and the third with "Poison Gases and Incendiary Bombs." The course will be given under the Fothergill Trust.

The lectures will be open to all Fellows of the Society, who can admit their friends personally, or by the usual tickets. Any Fellows requiring further tickets can apply to the Secretary, who will furnish them with any number they may desire for distribution. Tickets will also be issued gratuitously to any persons interested in the subject who may apply to the Secretary.

EXAMINATIONS.

The results of the Advanced Examination (Stage III.), held from May 10th–19th, were sent to the centres on June 29th. It is hoped to issue the Intermediate (Stage II.) results about the middle of this month, and the Elementary (Stage I.) early in August.

PROCEEDINGS OF THE SOCIETY.

ANNUAL GENERAL MEETING.

The one-hundred-and-sixty-first Annual General Meeting for receiving the Report of the Council, and the Treasurers' Statement of Receipts and Payments during the past year, and also for the Election of Officers and New Fellows, was held in accordance with the By-laws on Wednesday last, June 30th, at 4 p.m., COLONEL SIR THOMAS H. HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Chairman of the Council, in the chair.

THE SECRETARY read the notice convening the meeting, and the Minutes of the last Annual Meeting.

The following candidates were proposed, balloted for, and duly elected Fellows of the Society:—

Amenomori, Kikutaro, Nakanocho, Higashi-Sambongi, Kyoto, Japan.

Armstrong, Sir Charles H., care of The Chartered Bank of India, Australia and China, 38, Bishopsgate, E.C.

Armstrong, Sir Walter, Hon. R.H.A., 63, Carlisle Mansions, Victoria-street, S.W.

Bashiram, Sabgal, M.A., Assistant Engineer, P.W.D., Amritsar, India.

Blackmore, Henry Spencer, P.O. Box 145, Mount Vernon, New York, U.S.A.

Chandavarkar, Sir Narayan Ganesh, B.A., LL.B., Pedder-road, Bombay, India.

Chetty, T. N. Nacheapa, Ramachandrapuram, Pudukkottai State, S. India.

Davies, Rev. A. W., St. John's College, Agra, India.

Dawson, James Alfred, 18, Princess-street, Quittah, Gold Coast Colony, British West Africa.

Denning, John Renton, Punjab Chamber of Commerce, Delhi, India.

Devlin, Thomas, Lehigh-avenue, American and Third Streets, Philadelphia, Pa., U.S.A.

Dutt, Upendra Nath, 2, Puttuldanga-street, Calcutta, India.

Fox, Thomas, *Times of Malaya* Office, Ipoh, Federated Malay States.

Fujioka, Ichisuke, 21, Higashimachi, Azabu, Tokyo, Japan.

Gibb, Andrew, Messrs. Bathgate & Co., 19, Old Court House-street, Calcutta, India.

Grant, Alfred Charles, Montego Bay, Jamaica, British West Indies.

Gray, Joseph Milton, J.P., Georgetown, St. Vincent, British West Indies.

Gurney, Sir Eustace, Sprowston Hall, Norwich.

Horn, David Wilbur, A.M., Ph.D., Bryn Mawr, Pennsylvania, U.S.A.

Khan, Haziq-ul-Mulk Hakim Mahomed Ajmal, K.I.H., President, Anjuman-i-Tibbia, Delhi, India.

Leslie, Lieut.-Colonel F. M., Volunteer Headquarters, Strand-road, Calcutta, India.

Mishra, Pandita Damodardas, Hardwar, United Provinces, India.

Nakamatsu, Morio, Araijuku, Triarai Mura, near Tokyo, Japan.

Palanpur, His Highness Nawabzadah Taleymohommed Khan Saheb of, The Palace, Palanpur, North Gujarat, Bombay, India.

Porter, Thomas, Lilsdaal, Greenwood Park, Natal, South Africa.

Pybus, Ernest H., Liapari, Villa Lavella, British Solomon Islands.

Pyne, Charles A. Beynham, Grosvenor House, Calcutta, India.

Rau, J. Krishna, B.A., Napier-park, Madras, India.

Seshadri, Principal P., M.A., The Salem College, Salem, India.

Singh, Raja Durga Prosad, Lajbari, Jharia, Behar and Orissa, India.

Spackman, Mrs. Samuel, The Goring, Grosvenor-gardens, S.W.; and Philadelphia, U.S.A.

Starkey, Harold Augustus, A.M.I.E.E., care of Messrs. W. T. Henley's Telegraph Works Company, Ltd., 7, Hummum-street, Bombay, India.

Stone, Henry, British Consular Agent, Cerro de Pasco, Peru, South America.

Stringfellow, Charles Albert, British Consular Agent, Talca, Chile, South America.

Sutton, E. Stanley, care of Manáos Harbour, Ltd., 11, Adelphi-terrace, Strand, W.C.

Thornton, Thomas, Department of Agriculture, Ilorin, N. Province, Nigeria, British West Africa.

Wadleigh, Francis R., 426, Real Estate Trust Building, Philadelphia, Pennsylvania, U.S.A

Williams, David D., 17, Montpelier, Edinburgh.

The Chairman appointed Mr. Harold Oakley and Mr. H. B. Wheatley, D.C.L., F.S.A., scrutineers, and declared the ballot open.

The Secretary then read the following—

REPORT OF COUNCIL.

Before the commencement of the present session a notice was issued to all the Fellows indicating the line of action which it appeared to the Council the Society should pursue under the changed conditions in which the session opened. The notice pointed out that, as far as the Society itself was concerned, a condition of warfare was in its early years no novelty. Though the Society was started in a brief interval of peace, the first half century of its work was an almost uninterrupted period of war, and although not many references to war are to be found in the earlier volumes of the *Transactions*, the series of which commenced in 1783, yet in the very earliest records of the Society there are numerous indications of the effect of war upon the industries of the country. After Waterloo we had in Europe a century of peace, broken only by the short interval of the Crimean War; and now we are approaching the end of the first year of a conflict such as our country has never before known.

When this notice was issued at the beginning of last November, it was anticipated that the Society would suffer very heavy losses of numbers and consequently of revenue, and that there would be great difficulties in the way of carrying out its usual programme. As regards the business of the Society, it may be said that these anticipations have been in no way realised. The ordinary work has been carried through in the ordinary way, and, so far as regards the papers read and the attendance at the meetings, the present session compares quite favourably with any of recent years. As regards personal and pecuniary losses, the anticipations have not been realised to the extent which was expected. There has naturally been a heavy falling off in the number of new Fellows, only 148 having been elected in comparison with 227 last year. But the number of resignations caused by the war, though considerable, has not been as heavy as was feared. The total number of deaths and resignations for this session amounts to 287 as compared with 241 last year. The actual result is that there is a falling off in numbers of 139, and financially a reduction as compared with last year of £460 in annual contributions, besides £86 in Life Subscriptions.

As the Fellows are aware, the Society's revenues have fallen away during the past few years, and the additional losses caused by the war have brought the balance between expenditure and receipts to the wrong side. It was evident, therefore, that the Society had to fall back upon the accumulations of past years, which during the period from 1880 to 1905 reached the sum of over £20,000. Rather fortunately it happened that one of the Society's investments—£1,400 of Queensland

4 per Cent. Bonds—was paid off at the beginning of June, and the Council were thereby saved from the disagreeable necessity of realising any of their investments by a forced sale on a low and falling market. The transfer of the amount realised from capital to revenue has placed the Society in a satisfactory financial position for the time being. But the Fellows must understand that, unless further public support by the addition of new Fellows can be obtained, the Society cannot be continued on its present footing for any great number of years. That the Society has not suffered more than it has during a year of war is a matter for legitimate congratulation; but after the war is over, and normal conditions are again attained, the Society will have a certain amount of leeway to recover, and unless its Fellows make up their minds to support it, it may have to face a period of insufficient revenue, inadequate resources and impaired efficiency.

I. Ordinary Meetings.

The programme for the Society's evening meetings was, like everything else, gravely affected by the war. Several papers, already promised, had to be abandoned in consequence of their authors having joined the Army, or being occupied in national service at home. Eventually it seemed best to devote a certain number of evenings to subjects more or less connected with the war, and at the same time to continue the usual practice of providing a selection of papers of the ordinary character. In the outcome, a large proportion of the papers —nearly half, in fact—dealt with matters connected with industrial and economic questions arising out of the war, while the remainder were devoted to the usual topics with which the Society is concerned.

The opening Address of the Chairman, Sir Thomas Holdich, after dealing at some length with the Society's Examinations, turned to the discussion of a topic on which Sir Thomas is admittedly one of the best living authorities, that of surveying and map-making, and gave some interesting information about the newest details of that science.

The first two papers after the opening Address dealt with that question of industrial supplies to which attention was first devoted after the breaking out of the war, namely, the supply of chemicals. It has been for long a matter of common knowledge that almost the whole of the chemical reagents employed in industries in this country came from Germany. This is especially the case as regards drugs and the "fine chemicals" used for photographic and other similar purposes. Like conditions prevail in the case of industrial products produced by chemical methods. A typical instance of this last case is the supply of dye materials. The story has been told over and over again how the infant industry of the development of coal-tar colours originated in England, and, after being carried on to a considerable point of success, was transplanted to Germany, and there, by a combination of skilfully applied capital and wisely directed chemical research, developed into by far the greatest scientific industry which the world has ever known. The natural result was that the manufacture of coal-tar dyes, with all the innumerable products associated with their manufacture, came to an absolute cessation in England, which has been allowed to rely wholly upon Germany for all the chemical products required. The whole subject was very ably dealt with in the two papers above mentioned, one by Sir William Tilden, when Sir William Ramsay presided, and the other by Dr. W. R. Ormandy, when Lord Moulton was in the chair.

Of the similar papers which have been read since Christmas, there is nothing invidious in saying that by far the best was the admirable paper by Professor W. J. Ashley on "The Economic Position of Germany," which was read at the end of February. It was a masterly exposition by one of the most competent authorities in the country of the actual economic state of Germany, so far as it was known or could be known at the time. It received well-merited commendation from the press, both metropolitan and provincial, and performed a most useful service in providing the public with such information as was available about the present condition and future prospects of the enemy country.

Another extremely useful paper was the one read by Mr. J. A. Hunter on "The Textile Industries of Germany and Great Britain." Mr. Hunter pointed out very clearly what were the respective classes of goods which were mainly produced in the two countries, and showed what the goods were which we could produce in the most economical manner, and what others there were the manufacture of which we could perhaps take up in view of the probable altered conditions at the end of the war. On the whole, Mr. Hunter argued that we might look rather for a change than for the

extinction of trade, and he thought as British industry was financially better able to carry the burdens of war than German industry was, it was more likely to attract to itself trade hitherto German than is German industry to carry away business hitherto British.

A little later in the year Mr. Octavius Beale dealt generally with the expansion of British industry after the war, and suggested means by which a regular system of manufacture could be developed in the Dominions and Colonies. Another general paper was that by Mr. J. W. Gordon, who laid stress on certain points in the existing Patent Law which in his opinion hindered the transfer and development of hostile industries. A third was by Mr. Moreton Frewen, who suggested that the development of certain colonial fisheries might provide useful employment, not only for the surplus of our own fishermen, but for a considerable number of discharged soldiers after the war was over.

Lady Lugard's paper on "The Work of the War Refugees' Committee" should be mentioned in this category, as an interesting record of the vigorous and successful attempt which was made to grapple with the sudden emergency caused by the influx of Belgian refugees into this country.

The remaining papers read this year were of the ordinary general character, and it is satisfactory to be able to report that in value and interest they were quite on a level with those of recent sessions. It cannot, therefore, be said that in this respect the Society has suffered from the war. At the second meeting in December, Mr. W. A. Young, who was largely instrumental in the organisation of the attractive collection of British metalwork in the Victoria and Albert Museum, read a very interesting paper on "The Domestic Metal Work of the Eighteenth Century," the time when probably the greatest development took place in the manufacture of household wares, including stoves, kitchen utensils, and all the various wares of brass, tin, and pewter, which about this time, to a large extent, took the place of the utensils made of wood for poor folk, and of silver for rich ones.

At the last meeting before Christmas Sir William Abney gave the results of a long-continued series of experimental observations begun many years ago in order to test pigments for permanence of colour. His paper, which did not profess to contain much new information, was valuable as affirming or correcting various ideas as to the permanence or instability of certain colours. It is obvious that tests of this sort must extend over a long period of time, as it was not safe to assume before the fact had been verified that the effect of strong light for a short period on the fading of a tint is identical with the results produced by long exposure to a fainter light.

The Hon. John Collier's paper on Portrait Painting gave a clear and most interesting exposition of the technique of certain selected Great Masters, and showed how the principles founded on a study of that technique had influenced modern painters.

Mr. Vincent Brooks, than whom no one has a longer experience of the subject, gave an account of British Lithography in 1915, which may be looked upon as an interesting supplement to the valuable course of Cantor Lectures given last session by Mr. Joseph Pennell.

In his paper on "The Decorative Textile Industries and the Designer's Relation thereto," Mr. Arthur Wilcock seemed inclined to take a somewhat gloomy view of the designer's position. The most that the designer should expect was that he should be recognised by his fellow designers and a few experts in the trade. He need not look for general recognition, and his artistic aspirations must always be strictly subordinate to the dictates of fashion and commercialism. Mr. Wilcock also discussed the question of the education of the designer, and deprecated the present tendency of the Art Schools of the country, which, he urged, gave too little specialised training, and made no effort to connect the work of the students with trade conditions, the result being that large numbers of so-called designers were turned out every year who had no practical knowledge of the industries for which they proposed to design.

Mr. William Poel's paper on Shakespeare's Profession had the special interest of dealing with an art which has received but scant attention from the Society—a disregard which may be excused from the fact that the art of the actor is hardly capable of being associated with industrial applications. Having regard to the general condition of things in the country, the author showed a certain boldness in comparing, rather to our enemy's advantage, the management of German theatres as regards the production of masterpieces with those of this country. But Mr. Poel's views as to the importance of the actor's share as compared with the extraordinary development of scenic

appliances were thoroughly appreciated by the audience.

In his paper on "The Industrial Uses of Coal Gas," Mr. H. M. Thornton gave an exhaustive account of the numerous applications of gas to purely manufacturing purposes. It must have been more or less a revelation to all who are not specially cognisant of the developments of gas manufacture to know in how very many cases gas has taken the place of solid fuel for industrial purposes. This application of gas is of comparatively recent introduction, and the Chairman of the meeting mentioned the fact that when Sir Corbet Woodall took the chair at a meeting of the Society thirty-five years ago, he stated that at that time not more than 5 per cent. of the gas used was employed for purposes other than lighting. At present about 40 per cent. is so used, and yet it was the opinion of those best qualified to speak on the matter that this only marked the beginning of the era of the industrial application of gas.

It must be admitted that in his paper on "The Industrial Uses of Radium" Mr. Thorne Baker rather dealt with the future than with actual achieved results. He, however, gave a very interesting account of the experiments which had been made to test the effects of applying solutions of radium salts to aid vegetable growth, and held out considerable prospect that these experiments justified the expectation of valuable results in the immediate future.

Mr. A. S. E. Ackermann's paper on "The Utilisation of Solar Energy" was a very complete account of the various experiments made with a view of employing the direct heat of the sun for the production of power, and showed very clearly how far these results had been satisfactory. There seems every reason to hope that before long we may get in tropical countries engines driven either by steam generated directly by the sun's heat, or by some more direct application of solar energy.

Dr. Augustus Vernon Harcourt's contribution was mainly intended to describe a simple instrument he had constructed for the measurement of radiant heat from domestic fires, and a grate he had himself devised for the economical combustion of coal. It, however, contained also a good deal of information on the subject generally. An interesting side issue was his demonstration of the futility of expecting to increase the amount of heat generated from coal by the use of any nostrums applied to the fuel during combustion.

Mr. Charles Darling, in his paper on "Recent Progress in Pyrometry," may be said to have completed the information provided in his Cantor Lectures of 1911, by bringing the matter down to date; and he certainly showed that there had been very considerable progress made in Pyrometry since the admirable course of lectures referred to.

II. Indian Section.

Although the session was a difficult one in some respects, no falling off occurred either in the number or merit of the papers. The discussions also were for the most part quite up to the average, while the audiences throughout were as large as, and in some instances larger than, in normal times. With only one exception, the subjects selected for treatment related directly or indirectly to the war.

It was felt that the programme would be incomplete unless it provided an opportunity for the consideration of the effect of the widespread disturbance of peace on the external trade of India. That trade, so far as exports are concerned, was, until August last, largely carried on with the continent of Europe, Germany being, next to the United Kingdom, India's best customer. Mr. M. M. S. Gubbay, I.C.S., then in England on special duty connected with the war, agreed to read a paper on the subject, but was unexpectedly recalled to India to superintend the purchase and export of the surplus wheat supplies of that country. Fortunately the Society found an eminently qualified substitute in Sir Charles H. Armstrong, recently Chairman of the Bombay Chamber of Commerce, and a former member of the Bombay and Viceregal Legislative Councils. Having only lately arrived from India, Sir Charles Armstrong was in a position to give the Society first-hand information regarding the dislocation of trade brought about by the outbreak of hostilities, and to describe the measures taken to deal with the situation. "Looking back a few months, it is," he said, "wonderful how the Indian trade in merchandise has revived, and how rapidly India has adjusted itself to new conditions, and, in many cases, to much higher prices." There is, he was able to say, no reason at the present time to take a pessimistic view of the future. With respect to the not inconsiderable market in India for many kinds of goods previously obtained from Germany and Austria, he spoke hopefully of the efforts which are being made to capture that trade for English manufacturers.

Incidentally, he asked that the question of appointing a commercial man of fresh Indian experience to a seat in the Secretary of State's Council, a reform much desired by the mercantile community of India, might be favourably considered. The Marquess of Crewe presided, and his presence in the chair was noteworthy not only on account of the importance of the speech he delivered, but because it was almost his last public act as Secretary of State for India. In thanking his lordship for attending at a juncture when the call on his time was so great, the Chairman of the Section mentioned that for twenty years or more it had been the practice of Secretaries of State to show their interest in the work of the Society's Indian Section by on occasions taking the chair at its meetings; and Lord Crewe, in reply, said it was a distinct pleasure to him, as well as his duty, to follow the example referred to.

For some time past a once flourishing Indian industry, the cultivation of indigo, has been tottering to its fall. Formerly the value of the annual production amounted to between three and four millions sterling, and employment was afforded for many hundreds of young educated Englishmen; in 1914 the value of the out-turn was less than £70,000. Synthetic indigo, the successful rival of the natural product, having disappeared from the English market owing to the war, Indian indigo is for the moment at a premium, and this fact has strengthened the hopes, always entertained by at least a minority of their number, that prosperity may yet return to the Bengal planters. The question was fully discussed at one of the earlier meetings of the session, when an excellent paper, dealing with the position of the industry as a whole, was read by Dr. F. Mollwo Perkin. While advising the Indian growers to make the most of their present opportunity by increasing the area of cultivation and improving their methods, he expressed himself cautiously with reference to the prospects, say, three years hence. "If after a few years' trial it is found that the indigo planter is unable to meet the demand, and if it can be proved that better results can be obtained with synthetic indigo, then the natural indigo industry – like the natural alizarin obtained from the madder plant—must cease to exist." Nevertheless, he himself considers natural indigo best for many classes of material, and agrees that its use should be enforced in all contracts executed for State departments. The general tone of the discussion was not altogether optimistic; but one of the Mincing Lane experts who spoke thought that the Indian grower could compete with any synthetic indigo that it may be found possible to make in this country. This opinion is based on the assumption that English synthetic indigo cannot be sold at less than 1*s.* per lb., double the price of the Badische article.

Mr. Perceval Landon's brilliant and picturesque paper on "Basra and the Shatt-ul-Arab," which happened to coincide with important war despatches from the Persian Gulf, aroused much interest. After dealing with the history, geography, and political status of the "solar plexus of the old world," as he described Basra, and of the Shatt-ul-Arab, one of the outer gates of India, he indicated some of the problems that will have to be considered after the war in settling what is to be the future of Southern Mesopotamia. The most important of these problems is our responsibility for the development and good government of these vast alluvial flats. He submitted (1) that we have no right to abandon the regions without seeing that some form of what the Viceroy of India, Lord Hardinge, has called "benign administration" is secured; (2) that we cannot allow the country to return to the administration of Constantinople or Konia; and (3) that we have to protect much more than our own material interests. Earl Curzon of Kedleston, to whom, as Mr. Landon said, is due in a large measure the monopoly we have continued to maintain upon the waters of the Persian Gulf in spite of German intrigue, presided, and in the course of a powerful speech urged that it should be the immediate object of our diplomacy to detach the Arabs from the Turks, and to resume with the former those pleasant relations which have characterised our policy during the last fifty years. With regard to the intrigues referred to, he declared that there must be an end once for all to German influence in Lower Mesopotamia. Sir Hugh Barnes also contributed to a singularly instructive discussion, and brought forward facts, hitherto not made public, to show that until quite recently German gold was still being used to seduce the Arabs from our side to that of the Turkish interlopers.

At a meeting presided over by Viscount Bryce, an interesting paper on "The Indian Army" was read by Lieut.-Colonel Arthur C. Yate, formerly Commandant of the 129th (Duke of Connaught's Own) Baluchis. In setting forth

his "idea of the mould in which the Indian Army has been so shaped that it has become to-day a world power," he surveyed the successive great changes in the composition and organisation of that Army from the time when the nondescript forces of the old East India Company largely consisted, according to contemporary historians, of the "sweepings of the English ports," down to the present day, when their successors are constantly proving their value as fighters on battlefields in three continents. The historical section of the paper included vivid descriptions of famous Indian wars and of the deeds of some almost forgotten military heroes. Lord Bryce paid a fine tribute to the Indian forces at the front. They had, he said, shown themselves worthy compeers of our own troops and the troops of our Allies, not only in courage, but in endurance of hardships and unfailing loyalty. It was, he added, one of the redeeming incidents of a time so full of sorrow for all, that such a spirit of attachment should have been shown by the people and princes and troops of India to the British Empire.

The paper by Mr. H. J. Elwes, F.R.S., giving an account of the visit recently paid by him and Mr. Aubyn Trevor-Battye to Nepal, the home of the gallant Gurkhas, afforded the Society an opportunity such as only now and then occurs of hearing about a country which, though very friendly to the British ráj, is still quite inaccessible to Englishmen, whether travellers, sportsmen or Government servants, unless invited by the *durbar*. Mr. Trevor-Battye supplemented Mr. Elwes's entertaining narrative by supplying some admirable notes on the much-admired architecture and wood-carving of Nepal, specimens of which, as photographed by him, were shown on the screen. So far as circumstances permitted him to judge, the system of government prevailing in this secluded Himalayan State—paternal despotism—appeared to Mr. Elwes to be suited to the people, but, as an arboriculturist, he noticed with regret that the Maharaja's forests are not managed in a way that would enable them to supply the growing deficiency of timber in Bengal and the United Provinces, and thus become a valuable asset.

The remaining paper was read by Sir George Duff Sutherland Dunbar, and gave a very valuable description, based on personal inquiry, of the manners, customs and religious beliefs of the primitive Abor and Galong tribes living in the Brahmaputra Valley. Sir George Dunbar's evidently laborious investigations were chiefly made in the course of adventurous explorations undertaken by him while serving as an officer in the Assam Military Police. So replete was the paper with matter of ethnological and general interest that Sir Thomas Holdich and others acquainted with the North-Eastern border expressed the hope that in the near future Sir George Dunbar would expand it into a book.

III.—Colonial Section.

As usual four papers were read, the programme covering a very wide field, and dealing with many subjects of great interest.

One of the most pressing of the numerous and momentous economic problems that faced our rulers in August last was the threatened serious shortage of sugar, and the rise in the cost of that commodity to double the ordinary amount. The bold and effective measures taken by His Majesty's Government to reduce prices to something like the customary level, to keep the market well supplied, and to prevent a "corner" being created at the expense of the consumer, formed one of the many points discussed by Mr. Edward R. Davson in his able paper on "Sugar and the War." The main purpose of the paper was to direct attention to the danger of again relying upon foreign sources for so large a portion of our supplies—previous to the war 60 per cent. came from Germany and Austria—and to propose certain remedies. Speaking with intimate knowledge of the trade, Mr. Davson maintains that of the two million tons of sugar annually consumed in these isles, the major part ought to be, and in certain conditions can easily be, obtained within the confines of our own Empire. Those conditions briefly expressed are State encouragement of beet-growing in the United Kingdom, and the temporary repeal of the duty on Colonial imports. With regard to beet cultivation, he urges the Government to grant or guarantee the amount required, probably £250,000, to establish a factory on a sufficiently large scale to give the experiment a good chance of success. Finally, he asks that the question may be treated "not so much in accordance with the rules of text-books and traditions and creeds as in accordance with the needs of this country which emergency calls forth." In the speeches that followed Mr. Davson's views were generally supported.

In his admirable paper on the economic development of British East Africa and Uganda,

in which for some years past he has taken an active part, Major E. H. M. Leggett showed how the two great "Imperial estates" are complementary one to the other, each supplying something that the other lacks, so that the course of their expansion, in part due to organised effort and in part almost automatic, tends more to dependence upon a centralised programme. Lastly, he indicated something of what he believes to be the inevitable influence of these fertile territories as governing the economic future of about a third of tropical Africa, this power following from the fact that the port of Mombasa is the gateway of the shortest route to the great inland waterways—Lake Victoria, Lake Chioga, Lake Albert, and the head-waters of the Nile.

One attractive feature was the paper on "The Northern Territory of Australia," read by Mr. David Lindsay, well known for his explorations in that neglected but not unpromising region. Four and a half times the size of the Mother Country, endowed with magnificent harbours and rivers, possessing millions of acres of rich agricultural land, abounding in minerals, and with a climate, especially in the hinterland, not unsuited to white men, the total population of this great lone land is scarcely more than 3,500, and of these a thousand appear to be aboriginals and five hundred Chinese, the latter being employed in the mining industry. A little more than four years ago the Northern Territory was transferred from South Australia to the Commonwealth, and since then something has been done towards providing the indispensable railways; but otherwise, according to Mr. Lindsay, the results of the new *régime* so far are rather disappointing. That greater progress has not been made is, he suggests, due to the fact that the Commonwealth officials have not availed themselves of the knowledge and experience gained by South Australia during the forty-five years she had control of the Province. Until the railways recommended by the Royal Commission, of which he was a member, and estimated to cost between seven and eight millions sterling, are constructed, the Northern Territory, he says, will have no chance of being settled and developed. The High Commissioner (Sir George H. Reid), who presided, took a sanguine view of the prospects of the Territory, which he predicts will in time become "one of the most important parts of Australia."

Ten years ago a valuable paper on "The Use of Wood Pulp for Paper Making" was read at an Ordinary Meeting of the Society by Mr. S. Charles Phillips. At the closing meeting of the Colonial Section, on May 4th, the same gentleman read an equally valuable paper on "The Empire's Resources in Paper-making Materials." The advance made by the lucrative wood-pulp industry of Canada in the past decade was referred to, and much useful information given respecting the potentialities, particularly in suitable fibres, of other parts of the Empire. Our dependence on the Scandinavian countries for chemical and mechanical pulp, he pointed out, has not been without a certain amount of risk recently. With a ready market at its own doors and with contracts to fulfil, Canada could scarcely be expected to meet anything like the requirements of this country. Hence the greater need for exploiting and developing all our resources. Sir Daniel Morris, who took part in the discussion, spoke very highly of the possibilities of Newfoundland, whose proximity to these shores, illimitable supply of raw material, and cheap labour, appear to give the oldest of our colonies a "great advantage over any other portion of the Empire in the production of wood pulp and paper."

IV.—Cantor Lectures.

The first of the courses of Cantor Lectures for the past year was on "The History and Practice of the Art of Printing," by Mr. R. A. Peddie, whose interesting paper on the history of Colour Printing read in the previous year will be in the memory of those who are familiar with the subject. To condense into four lectures a history which extends over nearly five centuries was a task of no small difficulty; but by severe compression and careful selection Mr. Peddie accomplished his task satisfactorily. Of necessity, he dealt with the subject chronologically, devoting one lecture to the earlier history down to the end of the eighteenth century, while the second lecture dealt mainly with machinery and typography, the third to a large extent with black-and-white illustration, and the fourth with the later history of colour printing.

Of the three lectures which composed Dr. Mollwo Perkin's course upon "Oils, their Production and Manufacture," the first two were devoted to mineral oils, and the third to vegetable oils. In both cases the lecturer dealt with the sources of production and the treatment of the finished product. The

question of the uses of mineral oils, and of the various products derived from them, has been so fully treated before the Society in various lectures and papers, especially in the recent course of Fothergill Lectures on "Motor Fuel" by Professor Vivian Lewes, that Dr. Perkin was able to condense his remarks in this portion of the subject, and therefore to spare a whole lecture for the important subject of oils derived from vegetable sources.

Mr. M. H. Baillie Scott, in his course of lectures on House Building, dealt mainly with the artistic side of the question, and treated his subject partly historically and partly when he came to deal with houses of the present time—practically. The whole course was very fully illustrated with a number of interesting photographs of existing houses, old and new, many of the latter being of the lecturer's design.

The last course was by Dr. David Somerville on Foodstuffs. It dealt entirely with the biological, physical, and chemical side of the question. Dr. Somerville showed the nature of foodstuffs, and their action upon the human body.

V. FOTHERGILL LECTURES.

A course of three lectures was given last session under this Trust by Professor Vivian B. Lewes, who dealt with the subject of Motor Fuel. His first lecture dealt with the production and character of Petrol, his second with Petrol Substitutes, and his third with "Cracked" Spirits. The whole course was very appropriate to the present time, when the use of petrol as a fuel on land, on the water, and in the air has become so important for warlike purposes.

VI.—ALDRED LECTURE.

The fact of M. Paul Lambotte, Director of Fine Arts under the Belgian Ministry of Science and Arts, being now resident in this country—he, like so many of his compatriots, having been driven out of his own country by the war—led to his being invited to deliver a lecture under the Aldred Trust on Belgian Art. The precise subject selected by M. Lambotte was "L'Evolution de l'École Belge de Peinture (1830–1900)," and the result was a brilliant historical essay on recent masters of Belgian painting, delivered in his own language by the most competent authority on the subject.

The success of this lecture led M. Lambotte to offer to complete the treatment of the subject of Belgian Art by delivering before the Society a second lecture on Belgian Sculpture. The offer having been gratefully accepted by the Council, this lecture, under the title of "Constantin Meunier et les Sculpteurs Belges de son Temps," was given here on May 6th to a large and interested audience. The kindly service thus rendered to the Society has been recognised by the award to M. Lambotte of the Society's silver medal.

The cost of the Aldred Lectures is defrayed out of the funds bequeathed to the Society by Dr. George William Aldred, in 1868. The series was started in 1908, when the first lecture under the Trust was delivered by Sir William Ramsay, his subject being "A Radio-Active Gas." In 1909 Professor Arthur Dendy gave the Society a lecture on the Principles of Heredity, in 1910 Professor H. H. Turner lectured upon Halley's Comet, and in 1914 Sir Sidney Lee gave a discourse upon Shakespeare's life and work.

VII.—JUVENILE LECTURES.

The success of Mr. Plunket Greene's Cobb Lectures last year on "The Singing of Songs" led the Council to invite him to repeat them in a simpler form for the benefit of a juvenile audience last Christmas. The result was a success quite equal to the previous one. The charming manner in which Mr. Greene is able personally to illustrate his views on the proper treatment of vocal music delighted the less critical, but equally enthusiastic, audience of young people no less than it did the more serious students of musical art who had filled the lecture room a year ago.

VIII. ALBERT MEDAL.

The Albert Medal of the Society for the current year has been awarded by the Council, with the approval of the President, H.R.H. the Duke of Connaught and Strathearn, K.G., to Professor Sir Joseph John Thomson, O.M., D.Sc., LL.D., F.R.S., for his researches in Physics and Chemistry, and their application to the advancement of Arts, Manufactures, and Commerce.

The high value of Sir J. J. Thomson's researches in physical science is widely known and appreciated. There is probably no man alive at the present time who enjoys a higher scientific reputation than he does. The nature of his researches is briefly but adequately summarised in the words of the President of the Royal Society, Sir William Crookes, when

he announced the award of the Copley Medal to Sir Joseph :—

"His early work in the investigation of electrical phenomena showed he possessed a high degree of experimental ingenuity and skill; by his study of the passage of electricity through gases he elucidated the nature of the negative electrical particles, thus providing an experimental basis for the atomic theories of the nature of electricity. His treatise on the Conduction of Electricity through Gases won for him a world-wide reputation as a physicist to which subsequent work has added To him is due the investigation of the nature of the positive carriers of the electric charge; his method of positive ray analysis puts a new and extraordinarily valuable tool into the hands of investigators."

The nature of his work has been such, and so great has been the advance made by it in theoretical knowledge, that there has hardly yet been sufficient time for the application of his discoveries to those practical purposes which it is the special object of the Royal Society of Arts to recognise and to encourage. But the Council cannot doubt that before very long Sir J. J. Thomson's labours will have the same effect upon Applied Science as has been the case with the work of many of his illustrious predecessors, whose names will be found recorded in the list of recipients of the Albert Medal.

IX.—Medals.

The Council have awarded the Society's Silver Medal to the following readers of papers during the Session 1914-15.

At the Ordinary Meetings :—

Sir William A. Tilden, D.Sc., F.R.S., F.C.S., "The Supply of Chemicals to Britain and her Dependencies."

William A. Young, "Domestic Metal Work of the Eighteenth Century."

J. A. Hunter, "The Textile Industries of Germany and of Great Britain."

Hon. John Collier, R.O.I., "Portrait Painting: the Technique of the Great Masters."

Professor W. J. Ashley, M.A., M.Com., Ph.D., "The Economic Position of Germany."

Horace M. Thornton, M.I.Mech.E., "The Industrial Uses of Coal Gas."

A. S. E. Ackermann, B.Sc., Assoc.M.Inst.C.E., "The Utilisation of Solar Energy."

Charles Darling, A.R.C.Sc.I., F.I.C., "Recent Progress in Pyrometry."

In the Indian Section :—

Captain Sir George Duff Dunbar, Bt., "Tribes of the Brahmaputra Valley."

Lieutenant-Colonel A. C. Yate, "The Indian Army."

Perceval Landon, "Basra and the Shatt-ul-Arab."

Sir Charles H. Armstrong, "Indian Trade and the War."

In the Colonial Section :—

Major E. H. M. Leggett, R.E., D.S.O., "The Economic Development of British East Africa and Uganda."

Edward R. Davson, "Sugar and the War."

Of recent years it has been the practice that no medals should be awarded to readers of papers who had previously received medals from the Society. Acting on this rule the Council were precluded from considering the following papers:—

At the Ordinary Meetings :—

Sir William de Wiveslie Abney, K.C.B., D.C.L., D.Sc., F.R.S., "Testing Pigments for Permanence of Colour."

William Reginald Ormandy, D.Sc., F.C.S "Britain and Germany in Relation to the Chemical Trade."

John W. Gordon, K.C., "Patent Law Reform and the War."

Lady Lugard, "The Work of the War Refugees' Committee"

T. Thorne Baker, "The Industrial Uses of Radium."

In the Indian Section :—

Dr. F. Mollwo Perkin, F.I.C., F.C.S., "The Indian Indigo Industry."

The Council, however, desire to express their high appreciation of these papers.

The Council have also awarded a Society's Silver Medal to M. Paul Lambotte, Directeur des Beaux Arts au Ministère des Sciences et des Arts de Belgique, for his lecture delivered before the Society on "Constantin Meunier et les Sculpteurs Belges de son Temps."

X.—Owen Jones Prizes.

After the death, in 1874, of Owen Jones, a committee was formed to collect subscriptions for the purpose of founding a memorial, and the balance (a sum of £400) was presented to the Council of the Society of Arts upon condition of their expending the interest thereof in prizes to "Students of the Schools of Art who, in actual competition, produce the best designs for Household Furniture, Carpets, Wallpapers and Hangings, Damask, Chintzes, etc., regulated by the principles laid down by Owen Jones." The prizes have now been awarded annually since the year 1878 on the results of the annual competition of the Science and Art Department, and its successor, the Board of Education.

Six prizes were offered for competition last year, each prize consisting of a bound copy of "The Leading Principles in Composition of Ornament of Every Period," from the "Grammar of Ornament," by Owen Jones, and the Society's Bronze Medal.

A list of the successful candidates has already appeared in the *Journal*.*

The examiners who judged the works submitted for competition report:—

"The general level of merit is higher than that of last year, and a greater variety of treatment is shown throughout. The principles laid down by Owen Jones have been carefully observed, while the individuality of the students has not been fettered by their observance. Among the best examples submitted are designs for woven silks, wood-carving, machine-made lace curtains, cotton prints, stencilled fabrics, illumination, and pottery."

As already announced, the next award will be made in the current year. Six prizes have been offered for competition.

XI. Stock Prize.

In 1781 John Stock left £100 Consols to the Society, with the condition that the interest should be applied for the promotion of drawing, sculpture, and architecture. So long as the Society gave premiums in Art, the "Stock Medallion" was awarded for architectural designs and for sculpture. In more recent years various awards have been made under the Trust. Since 1893 a prize has been occasionally offered, as the accumulated funds permitted. The last award was in 1908.

A Gold Medal, or a prize of £20, was offered last year for competition among the students of the Schools of Art at the annual competition for a design for the best set of designs for an architectural decoration for the interior of a building, to be carried out in painting, stucco, carving, mosaic, or any other process.

The prize was awarded by the Council, on the report of the examiners in the National Competition of the Board of Education, to H. C. Harvey, of the Hackney Institute School of Art.†

XII.—North London Exhibition Trust.

For some years past the interest on the sum of £157, the surplus of the North London Exhibition held in 1864, has been devoted to the award of prizes to students of the Artistic Crafts Department in the Northampton Polytechnic Institute, Clerkenwell. At present an annual sum of £5 is placed at the disposal of the Governors of the Institute. This year four prizes were awarded in the senior section of the Department (one of £2, one of £1, and two of 10*s*.) and two of 10*s*. in the junior section. The awards were made on the recommendation of Mr. Alan S. Cole, C.B.

The names of the successful candidates have already appeared in the *Journal*.*

XIII.—Examinations.

A very important change was made this year in the arrangements for the examinations. Instead of holding the examinations at a single stated period in the year, two dates were fixed, one in March and one in May, at either or both of which any examination authority or local examination committee could hold its examinations.

It has long been felt that, especially as regards the higher grade examinations, the usual date in the early spring was inconveniently early for many educational authorities. When the classes in many subjects are continued up to Whitsuntide, it is obviously undesirable that an examination in those subjects should be held in March or April; the candidates' preparation is incomplete, and naturally it is difficult to induce students to resume their work after the examination has been held. On the other hand, this does not appear to apply with equal force to the elementary stage. The educational session ends sooner, and for various reasons the earlier date is more acceptable. Inquiries made a few years ago of some of the principal examination committees did not elicit a very definite opinion one way or the other; but the offer made by the Society to hold the examinations twice instead of once a year, which was submitted last year to the Education Department of the London County Council, was favourably considered and eventually approved by the Education Committee, but with the stipulation that the Committee should not be asked to superintend two full examinations. Therefore the original proposal was modified, so far as London was concerned, to the extent that the elementary examinations should be held before Easter, and the examinations in the two higher stages about Whitsuntide. This proposal was

* See *Journal*, July 10th, 1914, Vol. LXII. p. 729.

† Some further information about the prize and its founder will be found in the *Journal*, August 14th, 1914, Vol. LXII. p. 817.

* See *Journal*, April 16th, 1915, Vol LXIII p. 489.

also accepted by the principal independent London institutions who send candidates to the examinations. With regard to the rest of the country, it was evident that it would be difficult, if not impossible, to ascertain the views of all the educational authorities, and it was also tolerably certain that they would be divergent.

It was therefore decided that in the provinces the whole of the examinations in all stages should be held twice in the year, the date for the first examination in 1915 being fixed for March 22nd to 31st, and for the second examination May 10th to 19th. Notice to this effect was sent out to all the examination centres in July, 1914. Outside the administrative County of London, therefore, it was open to any authority to hold its examinations in any subject of any stage, either in March or in May, or at both dates if thought desirable. In London the elementary candidates were examined in March, and those of the two higher stages in May. It is satisfactory to be able to state that the new arrangement was greatly appreciated and worked with perfect moothness. The holding of two examinations in place of one caused considerable extra cost to the Society, and involved some additional labour on the part of the Society's staff, but it is certain that the change has been a useful one, and that it has been highly approved.

The arrangements for next year are under consideration, and will be announced at the earliest possible date.

Certain alterations were made in the syllabuses for various subjects. These alterations were intended to meet as far as possible the views believed to be held by the teachers of classes in those subjects.

No new subjects were added, but Accounting and Banking were separated, and now form two subjects instead of being combined in one. Company Law has been made into a separate subject instead of being included in Commercial Law. Commercial History was separated from Commercial Geography, and forms a separate subject under the title of Economic History.

Certain other alterations in the syllabuses were made, especially in the modern language subjects. In all these subjects certificates are now granted in the two lower stages on a general knowledge of the language alone. In Stage III. the candidates will be expected to specialise to a certain extent, and must show a literary, technical, commercial, or scientific knowledge, as well as a good general knowledge of the language.

For some years past the Society has expended a good deal of money in trying to encourage the study of the less popular languages, and has held examinations in Russian, Danish and Norwegian, Hindustani, Japanese, Chinese, Arabic, Swedish and Dutch. The old rule was that no examination would be held in any subject for which less than 25 candidates presented themselves, but this regulation was ignored in the hope that the numbers would increase if the study of the languages could be rendered more popular. As a result, taking the last six years, only 216 candidates entered, at a cost of about £350, and this, after deducting the £27 paid by the candidates in fees, meant a net loss of £323, or say £1 10s. per candidate. It was therefore determined to enforce the strict rule, and in consequence no examination was held this year in any foreign language, except French, German, Spanish and Italian.

The total number of entries for this year's examinations was 32,113 a falling-off of 5,861 as compared with last year, when there were 37,974 entries. Of these there were 14,427 in the March examinations, and 17,686 in the May examinations. The falling-off amounted altogether to 15 per cent. In the County of London there was a deficiency of 28 per cent. In the provinces generally the deficiency was only 11 per cent.

Naturally when the scheme for holding two examinations instead of one was first decided upon, it was anticipated that the result would be a considerable growth in numbers, and it may be considered as absolutely certain that the replacement of this increase by a deficiency is entirely due to the war. So far from a falling-off being surprising, it may fairly be said that much greater losses might reasonably have been anticipated. It is to be remembered that a large proportion of our male candidates in the two higher stages are of military age or just below it; and, further, that as a larger amount of overtime is now being worked candidates have no time to attend evening classes. So far as has yet been ascertained, the falling-off in such classes, especially those principally supported by young men, has been very great. In some of the large London Polytechnics the numbers of students this year are as much as 40 per cent. below those of last year; and in the London County Council Commercial Institutes, which supply a considerable proportion

of the London candidates, there has been a diminution of about 30 per cent.*

It was always a source of complaint that candidates had to wait a long time before they could know the results of their examinations. A new system of publication of the results of the examinations has been started this year and has been much appreciated. The candidates fill in a counterfoil attached to the paper on which they do their work; on these counterfoils the result of the examination is marked, and they are returned to the centres as soon as possible. By this means candidates are informed of the result of their examination some weeks sooner than in former years, when they had to wait until all the papers had been reported on and classified and the printed results issued.

The results of the March examinations were sent to the centres concerned, the Advanced on April 24th, the Intermediate on May 12th, and the Elementary Stage on June 1st. The examinations were held from March 22nd to March 31st.

The results of the Advanced Stage of the May examinations (May 10th–19th) were issued on June 29th, and those of the Intermediate and Elementary Stages will be sent to the centres as soon as possible.

As soon as all the work of examining the papers and classifying the examiners' returns has been completed, the whole of the results will be issued, as in previous years, in pamphlet form.

The usual full report on the year's examinations will be published in the *Journal* later.

XIV.—Practical Examinations in Music.

The Practical Examinations in Music were not concluded last year until June 27th, too late for the results to be included in the report of the Council. They lasted for eight days.

The examinations were conducted by Dr. Ernest Walker, M.A., and Mr. Burnham Horner.

The system of examination was the same as that for recent years. For instrumental music certain standards were given, and candidates were asked to select for themselves which of these subjects they chose to be examined in.

* The lately-issued report of the Board of Education, speaking of the effect of the war in diminishing the number of students at institutions supported or subsidised by Government, says: "For the Technical, Art, and Evening Schools it is not possible to give even approximate figures; but a number of the larger institutions have estimated the drop in the number of students owing to the war at points ranging up to 50 per cent., and averaging about 26 per cent."

The standards ranged from easy to very difficult music. For each standard a list of music was given for study, and from this list candidates selected the pieces they wished to sing or play. Candidates were expected to play or sing the pieces which they had prepared, to play or sing a piece, or portion of a piece, at sight, and to play certain scales.

In all, 249 candidates entered, and of these 244 were examined, a decrease of 29 as compared with the previous year. There were 196 passes and 48 failures.

The following were the subjects taken up - Piano, singing, and violin. 205 entered for the piano, 162 of whom passed; 33 entered for the violin, of whom 31 passed; 6 entered for singing, of whom 3 passed. No medal was awarded.

The examiners reported that the average quality of the candidates for the lower standards was perhaps slightly higher than usual, but a good many entered for the fourth standard without any prospect whatever of satisfying that severe test. In general, rhythmical vitality, clearness of phrasing, and variety of tone-colour were the chief desiderata among the pianists.

It was stated in the last report that the Council had under consideration the question of discontinuing these examinations, and eventually they came to the conclusion that the steady decrease in the number of candidates entering indicated that the examinations were no longer of much practical value, and they therefore decided not to continue them. This decision was announced in the *Journal* in September last.*

Last year's examinations were consequently the last of the series which began in 1879 and has been continued annually ever since for a period of thirty-six years. It was at the suggestion of Dr. Hullah that the Society first established examinations in Practical Music, that is to say, examinations at which the actual capacity of students to play an instrument, or to sing, could be tested. Dr. Hullah acted as examiner from 1879 till his death in 1884, and was succeeded by Mr. W. A. Barrett, who died in 1891. The work was continued by Sir John Stainer, Sir Joseph Barnby, and Mr. W. G. McNaught. In 1895, Mr. John Farmer was appointed, and he continued to act till 1899, when he was obliged to give up the work in consequence of illness, which, at a later date, terminated fatally. Since his death the examinations have been conducted by Dr. Ernest Walker and Mr. Burnham W. Horner,

* See *Journal*, September 25th, 1914, Vol. LXII. p. 919.

who served as Assistant Examiners to Mr. Farmer.

In the first year of these examinations (1879) 117 candidates were examined. This number increased gradually and intermittently to 276 in 1891, and to 395 in 1895. In 1896 certain changes in the system were introduced. No alterations have since been made. In that year there were 376 candidates; the numbers rose gradually to 546 in 1900, and reached 557 in 1904. That is the highest point ever reached. Since that year there has been an almost continuous falling off, until the low number was reached last year of 244.

In the year 1892 the Society offered to transfer these examinations to the Associated Board of the Royal Academy of Music and the Royal College of Music; but the Board would not undertake to carry them on at the low fee charged (five shillings), and nothing came of the proposal. Eight years later, in 1900, the question of continuing these examinations was again raised, and some further communications passed between the Associated Board and the Society, but again without result.

XV.—Viva Voce Examinations in Modern Languages.

Up to the present date twenty-three examinations have been held this year in London and Manchester, but it is doubtful if any more will be arranged before next spring.

At the examinations held up to the present date 453 candidates presented themselves, of whom 379 passed (173 with distinction) and 74 failed. The languages taken up were French, German, Spanish, and Italian. There is a decrease of 175 in the number of entries this year; this is accounted for by the fact that a large number of students from the London Polytechnics have joined the mobilised forces.

The results of previous years are as follows:—

Year.	Number Examined.	Passed.	Failed.
1902	280	202	78
1903	456	324	132
1904	540	375	165
1905	681	502	179
1906	644	469	175
1907	629	476	153
1908	615	467	148
1909	656	506	150
1910	642	495	147
1911	583	463	120
1912	633	516	117
1913	688	573	115
1914	628	492	136

It is satisfactory to note that the standard is well maintained. The reports of the examiners speak favourably of the knowledge evinced by the candidates. It may be noted that many of the unsuccessful candidates owe their failure to faulty dictation work.

These examinations are held at any of the Society's centres where the necessary arrangements can be made, at any date convenient to the local committee. The examination includes dictation, reading, and conversation, and is so arranged as to test efficiency in colloquial knowledge of the language, without laying too much stress on minute grammatical accuracy. Candidates who are reported upon as highly qualified by the examiners receive a certificate of having passed with distinction.

The Examiners are Mr. S. Barlet (London), and M. J. Bazin (Liverpool), for French; Professor H. G. Atkins (London), and Professor A. Johannson (Manchester), for German; Mr. J. M. Villasante (London), and Mr. W. F. Bletcher (Manchester), for Spanish; Mr. Luigi Ricci (London) for Italian.

XVI.—Honorary Royal Fellows.

In response to an invitation of the Council, addressed to him in April last, His Majesty the King of the Belgians graciously consented to allow his name to be added to the List of Honorary Royal Fellows. His Majesty was therefore, under the provisions of By-Law 61, elected by the Council.

His late Majesty King Leopold was one of the first two Honorary Royal Fellows elected in 1876, the other being His late Majesty the King of Sweden and Norway.

The other Honorary Royal Fellows of the Society are: The King of Spain (1905), The King of Norway (1906), The King of Sweden (1908), King Manuel of Portugal (1909), The Emperor of Russia (1909), and The King of Denmark (1914).

XVII.—Alien Enemy Fellows.

At their meeting on October 19th last, the first after the declaration of war, the Council determined to expunge from the List of Honorary Fellows the names of all persons of German and Austro-Hungarian nationality, and this has accordingly been done.

XVIII.—Barry's Picture of "Adam and Eve."

The picture of "Adam and Eve," by James Barry, R.A., which was presented to the Society

in 1834 by Mr. R. H. Solly, and has been on loan at the South Kensington Museum (now the Victoria and Albert Museum) since 1856, has been given by the Society to the National Gallery of Ireland, and has been accepted by the Governors and Guardians of that Institution.

Not much of Barry's work, except the series of paintings in the Society's Meeting Room, is now known to be in existence. There are very few specimens in any of the London public galleries, and these are all portraits. It is therefore very suitable that so good an example of a celebrated Irish painter's work should find a permanent home in the country of his birth.

The "Adam and Eve" was the first picture shown by Barry at the Royal Academy. The Society possesses an etching of the picture by the painter. The title is given on the plate as "The Temptation of Adam." *

XIX. Peter Le Neve Foster Prize.

Mr. Reginald Le Neve Foster has presented the Society with a donation of £140 for the purpose of founding a prize in commemoration of his father, Mr. Peter Le Neve Foster, who was Secretary of the Society from 1853 to 1879. Six generations of Mr. Le Neve Foster's family have been associated with the Society, and the connection extends from 1761, seven years after its foundation, to the present time. The original gift of £100, already announced in the *Journal*,† was made up to £140 so that an annual sum of £5 may be available.

The cordial thanks of the Council were voted to Mr. Reginald Le Neve Foster for his gift, which will help to perpetuate the memory of one who, during a long period of office, was highly esteemed and respected by the members.

XX.—Special War Lectures.

The Council felt that the Fellows would appreciate an opportunity of learning something about recent applications of modern science to purposes of war, and they have therefore arranged with Professor Vivian B. Lewes to give a short course of special lectures during the recess on "Modern Munitions of War." Three lectures will be given on three Wednesday afternoons next month.

The first lecture will deal with "Guns and Propellants," the second with "Mines, Shells, and High Explosives," and the third with "Poison Gases and Incendiary Bombs."

The lectures will practically be open free to the public, provided they apply beforehand for tickets. Fellows of the Society will of course require no tickets, and they can admit their friends personally, or by the usual tickets. Any Fellows requiring further tickets can apply to the Secretary, who can furnish them with any number they may desire for distribution. Tickets will also be issued gratuitously to any persons interested in the subject who may apply to the Secretary.

XXI.—New Council.

In accordance with the By-law regulating the election of new members of the Council, the following four Vice-Presidents retire from office as being the seniors on the list: Lord Sanderson, Sir Westby Perceval, Sir John Wolfe-Barry, and Lord Cowdray. A fifth vacancy was caused by the death of Sir John Lamb, which, as it occurred only in March, was not filled up by the Council. The vacancies caused by the deaths of Sir Charles Fremantle and Sir Owen Roberts were filled up at the time. To fill these five vacancies the Council now recommend the Right Hon. Arthur James Balfour, Sir Alexander Henderson, Bt., Lord Newlands, Major Percy MacMahon, and Mr. Carmichael Thomas. The first three named have not held office before; Major MacMahon retires from the Council; and Mr. Carmichael Thomas's term of office as Treasurer terminates in consequence of his having served for five years.

The four retiring Members of Council are: Colonel H. C. L. Holden, Major Percy MacMahon, Dr. William H. Maw, and Sir Aston Webb. In their places the Council recommend Lord Aldenham, Dr. Dugald Clerk, F.R.S., Sir Robert Perks, Bt., and Mr. James Swinburne, F.R.S. Lord Aldenham and Sir Robert Perks have not previously served on the Council. In place of the retiring Treasurer, the Council recommend Lord Sanderson.

XXII.—Obituary.

No less than three Members of the Council have died during the current year. The first of these was Sir Charles Fremantle, who died in October last. Sir Charles had been on the Council, with only short intervals, from 1895. Despite his age (he was over eighty), he was a very regular attendant, and his kindly nature and singularly charming manners rendered him very popular amongst his colleagues. Sir Owen Roberts died in January, and in him the Society lost one of the best friends and most earnest

* Some further information about the picture will be found in the *Journal*, May 7th, 1915, Vol. LXIII. p. 569.

† See *Journal*, July 24th, 1914, Vol. LXII. p. 769.

supporters that it has had for many years. From 1880 he served in one capacity or another on the Council, with a single interval of a year, and in 1905 he acted as its Chairman. Sir John Cameron Lamb, whose death took place at the end of March, was first a Member of the Council in 1906; in 1910 he became its Chairman. For some time before his death his serious illness prevented his attendance at the meetings of the Society, or of the Council; but, until his health failed, he was a very active and useful member.

Lord Rothschild was a Vice-President from 1901 to 1905, but he had not since been on the Council. Sir Charles Hartley, the eminent engineer, was a Vice-President for three years from 1903. He had attained the great age of ninety at his death. Lord Merthyr, who was then Sir William Thomas Lewis, served as a Vice-President from 1907 to 1909.

Sir Charles Crosthwaite was for the last nine years a member of the Indian Section Committee, and on several occasions he occupied the chair at the meetings of the Section. At the time of his death Mr. George N. Hooper had been a subscribing member for sixty-five years. He was elected at the beginning of 1850, and was the oldest of the Society's members. When the Technological Examinations were established, Mr. Hooper acted as examiner for carriage-building, and on two occasions he read papers on that subject before the Society. Mr. Walter Hunter, the well-known water engineer, read a paper here in the year 1899. Sir James Rankin, who had been a member since 1877, read a paper on "The Duty of the State towards Emigration" in 1883. Mr. R. F. Chisholm read a paper in the Indian Section on the Taj Mahal in 1911.

Mr. Edward Riley was a very old member of the Society, which he joined in 1875. He was eighty-three at the time of his death, and it was some time since he had attended any of the meetings, at which, earlier in his life, he was a frequent attendant. Mr. J. F. S. Gooday was for many years the General Manager of the Great Eastern Railway Company. Mr. William Willett had a good reputation as an artistic builder, but his name was best known in connection with his energetic recommendation of what he termed daylight saving—a proposal for legally altering the proper time during certain periods of the year, with the object of inducing people to make greater use of daylight by earlier rising. Sir Robert Walton had been President of the British Chamber of Commerce in Paris, and took an active part in many matters connected with the welfare of his countrymen in that city. Sir Charles Seely, for many years the well-known Liberal member for Nottingham, had been a member since 1871. Dr. Samuel G. Smith was an eminent American sociologist and criminologist. He was also well known in this country. Mr. H. B. Hederstedt was an eminent Indian railway engineer. Mr. George F. Pollock was for many years a Master of the Exchequer Court and Supreme Court and King's Remembrancer.

Mr. J. C. Powell was a member of the well-known firm of glass-makers. Mr. Henry Maull was one of the first professional photographers, but he had retired from business some thirty years ago. His membership of the Society dated from 1861. Colonel W. B. Bryan was Chief Engineer to the Metropolitan Water Board, having previously held the post of Chief Engineer of the East London Waterworks. Mr. William de Hertburn Washington was a well-known American engineer. He was a descendant of Charles Washington, a brother of George. Mr. Alfred Sang, an engineer of reputation in America, France, and England, volunteered for the Intelligence Corps on the outbreak of the war, but received a wound from which he died in October last. Mr. Alfred H. Baynes was for long General Secretary of the Baptist Missionary Society, and had been a member of the Society for over forty years. Mr. Charles E. Chrimes was a member of the well-known firm of Guest and Chrimes, foundry and general brass works, of Rotherham. Mr. William Ewing was a director of the African Lakes Corporation, and he rendered considerable service in extending British rule over the territories north of the Zambesi. Mr. James Spicer was a member of the well-known firm of paper-makers. Mr. Bernard Le Neve Foster was the seventh son of Mr. Peter Le Neve Foster, for long the respected Secretary of this Society. Major J. A. Travers was a prominent member of the Fishmongers' Company, and an active supporter of the proposed amalgamation of the Society with the London Institution, of which he was a member.

Notices of all the above, and of some other Fellows who have died during the past twelve months, will be found in the columns of the *Journal*.

XXIII.—Finance.

The annual statement of receipts and expenditure was published—in accordance with the usual practice—in the *Journal* last week.

It shows the revenue and expenditure for the financial year ending May 31st last, the assets and liabilities of the Society, its investments and the Trusts standing in its name.

As mentioned in the first paragraph of this report, the Queensland 4 per Cent. Bonds held by the Society were paid off on the 1st of this month. The amount, £1,400, actually realised £1,413 17*s*. In the ordinary course of events this would have been reinvested, but the Council were compelled to utilise this amount as ordinary revenue, and to apply the money in discharge of the Society's liabilities. The deficiency in the Society's income from subscriptions and life contributions, as compared with last year, amounts to nearly £550, and there is also a large falling-off in the receipts from examinations, which only amount to £3,646 10*s*. 6*d*., as compared with £4,320 4*s*. last year. As the expenses of the examinations appear in the balance-sheet as £4,522 2*s*. 7*d*., there is a loss of about £875 on this head. It should, however, be explained that this is not a loss on this year's working, since the receipts are those of 1915, and the amount on the other side represents the payments on the previous year's examination. The receipts, therefore, are diminished in consequence of the reduced number of this year's candidates, while the payments are those incurred for the larger number examined in 1914.

THE CHAIRMAN (Colonel Sir Thomas Holdich, K.C.M.G., K.C.I.E., C.B., D.Sc.), in moving the adoption of the report—which he considered most excellent and drawn up with very great care by the Secretary—thought that it was, on the whole, certainly encouraging and satisfactory. He wished to draw the attention of the Fellows to the fact mentioned in the report that the Society had as much as £20,000 reserve capital to fall back upon in such times of stress, which spoke exceedingly well for the careful manner in which the Society's finances had been nursed. He also observed that the accumulation began at the time the present Secretary came into office, and this was one of the many services for which they had to thank their Secretary, Sir Henry Wood. The difficulties which the Society had to face were caused by the war, and he particularly wished to call the attention of the Fellows to the paragraph at the commencement of the report, in which it was stated that, although the Society had not suffered as much as was anticipated during the year, which was a matter for congratulation, yet after the war was over and normal conditions were re-established, we should have a certain amount of leeway to recover, and that unless the Fellows made up their minds to support the Society, it might have to face a period of insufficient revenue, inadequate resources, and impaired efficiency. He felt that the Fellows were quite as capable as himself of judging what the effects of the present crisis were likely to be in the future as regards the prolongation of the war. It was, therefore, incumbent upon all the Fellows to do their utmost to support the Society, not only individually, but also in obtaining new Fellows. The Council had been endeavouring that the Society should, by means of its lectures and other work, take some part in matters connected directly or indirectly with the war, which he thought was entirely as it should be. He did not think the Society could expect practical assistance from the public unless some such measures were taken, and partly for this reason the special course of lectures on War Munitions by Professor Vivian Lewes, had been arranged for delivery in July. He anticipated that these lectures, which were open to the public, would attract very great attention. He was very glad to think that it had been possible for the Society to adopt some method of ventilating matters connected with the war, which would appeal directly to the public.

SIR STEUART COLVIN BAYLEY, G.C.S.I., C.I.E., had the very greatest pleasure in seconding the adoption of the report. He also wished to add that the report was one of the best he had read during his twenty years' connection with the Society, and he had found it exceedingly interesting. He commended to the notice of the Fellows what the Chairman had stated with regard to the position of the Society after the war had ended. He also considered that the functions of the Society should be adapted as far as possible to the subject which was in all our minds—that of the war, and he congratulated the Council on having arranged for the special War lectures by Professor Lewes.

After the CHAIRMAN had pointed out that the report was open to discussion by the meeting, the adoption of the report was agreed to.

THE CHAIRMAN proposed a cordial vote of thanks to Sir Henry Trueman Wood (the Secretary), Mr G. K. Menzies (the Assistant Secretary), Mr. S. Digby (the Secretary of the Indian and Colonial Sections), Mr. George Davenport (the Chief Clerk), and Mr. J. H. Buchanan (Accountant), and to the other officers of the Society for their services. It hardly seemed necessary, he said, for him to say how much they were all indebted to Sir Henry Wood and the other officers of the Society for the careful attention they had given to the affairs and interests of the Society, and for the successful way in which the business of the Society had been conducted throughout the past year. He thought the Society was exceedingly fortunate in having had

the ripe experience of Sir Henry Wood to steer them through their present difficulties.

THE SECRETARY returned thanks for this expression of continued confidence in himself and in the other officers of the Society. He said he naturally felt some sorrow that when the time of his term of office as Secretary was drawing to a close the Society would not be in the same prosperous condition as it had been for some time past. The fact, however, had to be faced that the Society was entering upon a period of lean years, after the comparatively fat years he was thankful to say it had enjoyed during the past twenty-five years. But we all hoped that the bad times would soon pass away. The Society during its long career had had its bad days as well as its good, and he could see no reason why, after the war was over and people had time again to think of arts, manufactures, and commerce, it should not be as prosperous as ever it was.

The ballot having remained open for half an hour, and the scrutineers having reported, the CHAIRMAN declared that the following had been elected to fill the several offices. [The names in *italics* are those of members who have not, during the past year, filled the office to which they have been elected.]

PRESIDENT.

H.R.H. The Duke of Connaught and Strathearn, K.G.

VICE-PRESIDENTS.

Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S.
Viscount Alverstone, G.C.M.G., LL.D., D.C.L., F.R.S.
Sir George Ranken Askwith, K.C.B., K.C., D.C.L.
Right Hon. Arthur James Balfour, LL.D., D.C.L., M.P., F.R.S.
Sir Steuart Colvin Bayley, G.C.S.I., C.I.E.
Duke of Bedford, K.G.
Sir George Birdwood, K.C.I.E., C.S.I., M.D., LL.D.
Lord Blyth.
Earl Brassey, G.C.B., D.C.L., LL.D.
Sir Henry Mortimer Durand, G.C.M.G., K.C.S.I., K.C.I.E.
Sir Alexander Henderson, Bt., M.P.
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On the motion of the CHAIRMAN a vote of thanks to the scrutineers was carried unanimously.

SIR PHILIP MAGNUS, M.P., proposed a very hearty vote of thanks to the Chairman, not only for his services in the chair that afternoon, but also for the great attention which he had given to the affairs of the Society during the whole period he had occupied the important post of Chairman of Council. Sir Thomas had always taken the deepest interest in the Society's work, and had been a great help to the Council.

SIR BOVERTON REDWOOD, Bt., D.Sc., F.R.S.E., said he had very much pleasure in seconding the vote of thanks. He felt sure they all fully appreciated the extent of the services of Sir Thomas Holdich, and how much the Society was indebted to him for the active interest he had continuously shown in its affairs. He considered the Society had always been conspicuously fortunate in its Chairmanship, and he should like to be permitted to add that it had never been more fortunate than in the present holder of the office.

THE CHAIRMAN, in acknowledging the vote of thanks, said that not only had it been a great pleasure to him to serve as Chairman of Council, but it had also been a great advantage to him, for although he was getting on in years he was not too old to learn; and he had learned more in the course of the last two years with regard to many and very varied subjects than he could have accumulated as knowledge in any other way.

The meeting then adjourned.

NATAL FISHING INDUSTRY.

In accordance with a desire expressed by the Provincial Council, the Administrator of Natal last year appointed a committee to inquire into various matters connected with the Natal fisheries. The

committee reported in November, recommending the appointment of a Fisheries Advisory Board, and such a Board has now been appointed. The Board considers matters relating to Natal fisheries, and makes its recommendations thereon to the Provincial Government.

The most important matter demanding the Board's attention is the revision of the fisheries laws and regulations of the province, which are in a bewildering condition. A consolidating measure is expected to be introduced in the next session of the Provincial Council.

The efforts of the Board will have to be directed to the opening up of new markets for the industry. The Johannesburg market is by far the most important in South Africa, but fish caught off the Natal coast cannot compete there with fish caught off the Cape. The reason for this is that at the Cape the fish are trawled, but at Durban they are caught by the line, and the latter method is, of course, the more expensive. If fishing-grounds suitable for trawling were discovered off the Natal coast, Natal fish might be expected to enter the Johannesburg market.

In the absence of markets in South Africa to absorb large quantities of Natal fish, the question of curing and canning for export is all-important. According to the Report for 1911 of the Durban Chamber of Commerce, attempts to establish a fish-curing industry at Durban have been made from time to time, but with little if any success. Recently an important fishing concern in South Africa made serious attempts to cure fish in Durban, but found that the treatment employed by them elsewhere could not be applied successfully to Natal fish. The temperature of the sea off Natal is higher than that of the sea off the Cape, and the difference in temperature is reflected in the nature of the flesh of the fish. The Natal fish probably contains less oily substances than the Cape fish. These and many other questions will have to be settled before the rich harvest believed to be awaiting the fisherman on the Natal coast can be gathered in and marketed.

The following is a statement of the fish captured at Durban in the last two years:—

	Quantity			
	lbs	£	lbs.	£
By sea-going craft.	2,399,648	23,717	2,257,191	23,367
By seiners and others	325,701	3,048	322,256	3,108

SUGAR-MILL MACHINERY FOR WEST CHINA.

Some interesting indications are given in a recent report by the American Consul at Chungking as to openings which at present exist for the supply of sugar-mill machinery in West China. He states that large quantities of sugar-cane are grown in West China, one variety of which—reddish-purple in colour and 5 to 8 ft. in height, with a diameter of 1 to 1½ in.—is sold in its natural state for chewing, being succulent and of excellent flavour. The crop is harvested in November, but the canes are buried in such a way that they keep for many months, and are taken up and sold according to the market demand. The cane from which sugar is made is known as white cane, and is considerably taller, though of smaller diameter, than the red variety. It is very rich in saccharose, and is a most important crop in the Neichiang and Tzechow districts. This cane also ripens in November, but is frequently seen in the fields as late as February.

The apparatus used in extracting, evaporating, and refining the cane juice is exceedingly primitive. The cane is passed between stone rollers turned by water buffaloes, the juice being collected in a large vat underneath the rollers, and conducted to a tank connected with the evaporating plant. The evaporating equipment consists of large iron pans of local manufacture heated by a coal furnace, coal being abundant and cheap in the sugar-growing localities. The first process of refining consists merely in removing the scum that gathers on the top of the liquid. After the juice is partially evaporated it is allowed to cool, and is then ready to be placed on the market as "brown sugar"—a viscous mass quite different from the article known to the Western market as brown sugar. It is not only consumed locally in large quantities, but is also shipped to other provinces. What is known as white sugar is manufactured from brown sugar by further refining and by bleaching in the sun. This sugar is much superior to the brown, and is about twice as expensive. There is no doubt that present manufacturing methods could be much improved. A greater recovery of juice per ton would follow the installation of modern crushers, and a much higher grade product would result from the employment of better methods of evaporation, and the introduction of lime and charcoal in the refining processes.

The Chinese sugar producers themselves realise the necessity for obtaining up-to-date machinery. Just prior to the recent revolution several of them combined and sent a delegate to study sugar-growing and manufacture in Formosa. Unsettled political conditions, however, seriously interfered with their arrangements, and the plans were temporarily abandoned. Now that the situation is more settled, there is a reviving interest in the project of purchasing a complete sugar-mill

equipment. This is especially true of the three important sugar-growing centres of Neichiang, Tzechow, and Pachow.

What will first be needed at Tzechow is a centrifugal equipment for making brown sugar, the plant to turn out about 10,000 lb. a day; an evaporator and a crusher of corresponding capacity will also be needed. While there are no individual producers who are at present doing business on this scale, it would be possible for several of them to unite for this purpose.

Manufacturers of sugar-mill machinery should keep two points in mind if they desire to supply equipment to West China. The field is sufficiently important to warrant the sending of a personal representative here; if it is not practicable to send such a man from home some one sent by an agency in Shanghai could canvass the situation. Convincing explanations are very difficult to make by mail, especially to Chinese, who are unfamiliar, except in a general way, with the needs of the industry. British and German firms are ready to solicit trade through personal representatives, and this means has proved to be the most effective.

It is equally important to remember that first orders should be accepted on as favourable terms as possible. A sufficient amount of machinery can be sold later to offset any loss on the first order, and those who secure the first orders are likely--especially in China--to get the rest of the business.

THE SILK INDUSTRY IN BULGARIA.

The silk industry in Bulgaria may be said to be in its infancy, for it was not until the country had thrown off its allegiance to Turkey, in 1908, that any organised attempt was made to encourage the rearing of the silkworm.

From its geographical position, Bulgaria is pre-eminently a favoured region, the climate is dry and warm, and, excepting in the high mountainous districts, the mulberry tree flourishes everywhere, even at an elevation of more than 3,000 ft. above the sea-level.

In the southern provinces the cultivation of the mulberry tree and the rearing of silkworms are among the principal occupations of the inhabitants.

The cultivation of this tree, which, under Turkish rule up to 1908, scarcely covered an area of 1,600 hectares (3,952 English acres), had almost doubled by 1912.

The Government is doing its best to encourage the extension of the mulberry plantations by the gratuitous distribution of seed amongst the landowners and peasantry.

Instruction in the art of silkworm rearing is given in all the agricultural schools throughout the kingdom. Special instruction, both practical and theoretical, is given at the three principal centres of sericulture, namely, Sadovaj, near Philippopolis, at Orhanic, and at Vratza, a town to the north of Sofia, where a school of practical weaving also has been established.

The mulberry tree is generally grown in special plantations. The trees are usually grown as standards on a single stem, one metre in height. They are sometimes grown as shrubs, with a number of stems branching from the roots. They are usually planted at regular distances of about 2 metres (6 ft. 6 in.) apart. The ground is generally cultivated and planted with maize, potatoes, and garden crops, beneath the trees during the first four years. The trees are also grown, as in Italy, in the open fields, in vineyards, and on the sides of roads.

Generally speaking, the rearing of silkworms, as yet, in Bulgaria leaves much to be desired as regards cleanliness and hygiene, and in some cases is very primitive. Where rational systems are adopted, as in Japan, the cocoons produced are of first-class quality, whilst the others are poor and dirty and consequently fetch lower prices. By existing law in Bulgaria, all "seed" (eggs) used for hatching the worms must be prepared by the Pasteur method, and eggs so prepared may be imported from other countries, especially from France, Italy and Turkey.

According to the latest available statistics, Bulgaria imported in 1911 from

Italy	269	kilogs, to the value of	35,836 francs.
France	346	,, ,, ,,	46,168 ,,
Turkey	21	,, ,, ,,	2,800 ,,
Total	636	,, ,, ,,	84,804 ,,

= 22,430 ounces (avoirdupois) . . . £3,392.

The quantity and value of silkworms' eggs imported every year seem to be decreasing, as shown by the following figures:—

	Kilogs.		Francs.	£ Sterling
1907.	724	to the value of	127,985 =	5,119
1908.	723	,, ,,	106,678 =	4,265
1909.	583	,, ,,	64,171 =	2,586
1910.	497	,, ,,	61,085 =	2,443

The climatic conditions in the southern parts of Bulgaria are more favourable than the north for the rearing of silkworms and the production of mulberry leaves.

The eggs produced from the white cocoons give a larger yield than those from the yellow, being at the rate of 60 kilogrammes (132 lb.) of silk cocoons per ounce of eggs for the first and only 40 kilogrammes (88 lb.) for the second.

The chief kinds of silkworms' eggs in demand in Bulgaria are the "White Bulgarian," the "yellow French," from the Department of the Var, the hardy "Salonika" and the "Italian."

The principal markets for the sale of cocoons are at Vratza, Stanimaca, Hazmanli, Sofia, Gumulgina and Ortakeni.

The silk-reeling industry, which, previous to the last two wars in the Balkans, was but little developed, may now be said to be almost extinct. In Old Bulgaria, at Stanimaca, there was one establishment with 80 reels, which

has been closed for the last two years. The same may be said for another at Sofia (New Bulgaria), belonging to an Italian firm, with 40 reels, and also one with 80 reels at the same place.

The principal causes of the depression of this industry in Bulgaria must be attributed to the general state of unrest in Europe, and the low prices which prevail generally on the silk markets of the world.

The imports of manufactured silk goods to Bulgaria tend to increase, and the value of these goods imported in 1911 from the following countries amounted to:—

	Francs
Austria-Hungary . .	90,384
Switzerland	183,874
France	111,411

WATTLE-BARK SUPPLIES OF BRITISH COLONIES.

Certain tanning materials, such as wattle-bark, in ordinary times find on the Continent their chief markets, which are now closed. Large supplies of the bark are therefore available. They are needed in the United Kingdom, which usually imports large quantities of vegetable tanning materials from the Continent.

Wattle-barks are derived from several species of acacia, which are indigenous to Australia and have been introduced into south and east Africa. The production of wattle-bark is an industry of the greatest importance to South Africa, especially to the province of Natal, and, according to a recent report by the United States Consul-General at Capetown, is rapidly increasing in magnitude. The following table shows the exports of wattle-bark from the Union of South Africa and the approximate average price, per long ton of 2,240 lb. for chopped bark in London from 1909 to 1913 inclusive. The figures show that the price has gradually declined as supplies increased:—

Years	Tons.	Price per ton
1909 . .	36,771	£8 10*s*. 0*d*.
1910 . . .	41,344	£8 2*s*. 6*d*.
1911 . . .	49,645	£8 7*s*. 6*d*.
1912 . . .	52,776	£7 5*s*. 0*d*.
1913 . .	65,052	£7 5*s*. 0*d*.

At the close of 1913 the English market prices for bark were about £7 per ton for "fair average quality," and about £4 19*s*. per ton for poorer quality. The price on October 29th, 1914, was £7 15*s*. for chopped bark.

The following statement shows, in hundredweights of 112 lbs., the exports of tanning bark from the Commonwealth of Australia to the principal countries of destination during the years 1911, 1912 and 1913. The term "tanning bark" includes barks other than wattle-bark, so that the exports of wattle-bark cannot be exactly stated.

Countries	1911	1912.	1913
	Cwt	Cwt.	Cwt
Germany .	148,490	49,849	58,011
Belgium .	29,100	10,180	36,250
New Zealand	65,677	63,310	45,013
Other Countries	9,107	4,349	5,078
	252,374	157,688	144,352

The Chairman of the Wattle Growers' Association in British East Africa states that over 12,000 acres have been planted with wattle in that Protectorate. According to the local Department of Agriculture, the extent of the plantations ready to be harvested for bark is not yet large, but during the next two years the annual output is expected to amount to about 7,500 tons.

Extract.—The average amount of tannin in commercial wattle-bark is 32 per cent. Thick wattle-bark is almost invariably richer in tannin and of better colour than thin bark, and realises better prices.

The material is chiefly used in Germany for the production of heavy leathers, but it furnishes a full, soft leather with calfskin, and might well be used for the production of light leathers.

Leather tanned with wattle-bark has a faint reddish tinge, and the colour darkens slightly on continued exposure to light, but not more so than that of leather tanned with oak or hemlock bark or extract.

Concentrated tanning extracts are now being increasingly used in place of barks and other tanning materials in their natural condition. This fact is recognised in South Africa, where a factory for the manufacture of a solid extract from wattle-bark is being erected and equipped.

GERMAN EXPORTS TO RUSSIA BEFORE THE WAR.

Previous to the war, Russia was the great market for every description of goods "made in Germany."

A few extracts from an article in the *Ruskoie Slavo*, reproduced in an Italian paper for the benefit of manufacturers in that country, will give some idea of the magnitude of the trade that it is proposed to capture.

Amongst some of the most important branches may be mentioned agricultural machinery and implements, amounting to 4,344,000 puds* (70,064 English tons) of the value of 11,744,000 roubles (£1,249,362) annually. Of this, from 32 to 85

* The Russian pud = 36·12 English lbs. = about 62 puds to the English ton. Rouble = about 2*s*. 1½*d*., or 9·4 roubles = £1 sterling

per cent. was imported from Germany. Of the 28,450,000 puds (458,871 tons) of phosphates and other fertilisers imported annually by Russia to the value of 9,809,000 roubles (£1,085,639), the percentage from Germany varied from 29 to as much as 96.

Of iron and steel manufactures, of which 11,481,000 puds (185,177 tons) to the value of 21,086,000 roubles (£2,243,191) are imported, the percentage of German make ranged between 43 per cent. and 95 per cent. Of cutlery, needles, locks and other ironmongery goods, of which 786,210 puds (12,680 tons) are imported to the value of 2,833,000 roubles (£301,388), from 71 to 99 per cent. were supplied by Germany.

Of copper and its alloys, amounting to 786,210½puds (12,680 tons), of the value of 11,645,000 roubles (£1,238,830), the percentage ranged between 54 to 90 from Germany.

Of textile materials to the value of 22,407,000 roubles (£2,383,723), 58 to 94 per cent. came from Germany.

Of electrical machinery, etc., 605,700 puds (9,770 tons), to the value of 15,098,000 roubles (£1,606,170), the percentage imported from Germany ranged from 86 to 96 per cent

ARTS AND CRAFTS.

Stained Glass.—Stained glass was one of the earliest crafts to be affected by the renewal of interest in the applied arts. After langu shing for a long period, it awoke to find itself of primary importance in the days of the Gothic Revival. That was, perhaps, an unfortunate moment for its resuscitation, for it was many a long day before anything was commonly expected or even tolerated in stained glass but a rather servile imitation or adaptation of Gothic models. The considerations of archæology rather than of art were regarded as of paramount importance, and what was demanded of the worker in stained glass was, for the most part, not that he should produce work in which there was any life, but that he should conform carefully and rigorously to precedent. He was asked to be content to do what had been done before. The prevailing passion for Gothic had, however, one great advantage, the good results of which have lingered to the present time. It turned the eyes of the artist in stained glass away from the heavy, muddy, and altogether unglasslike painted work of his immediate predecessors, towards the brilliant, jewel-like glass of the Middle Ages, which relied for its beauty on the quality of its pot-metal glass and the skill with which the glazing was designed rather than on the dexterity of the painter. Again, though the greater part of the nineteenth-century glass was perforce produced in strict conformity to tradition, the work of Morris and Burne-Jones and a few less well-known artists accustomed the public in time to the idea that the art of stained-glass making was a living craft with lessons to learn, not only from the past but also from the present. It cannot be said that the old conditions have entirely passed away. There is still a demand for windows "in the style of the church," which, being interpreted, too often means designed on a stereotyped plan; but for all that there is an increasing understanding of the fact that good work must be more or less original, and that it is not necessary that a window, to be in keeping with, say, a fourteenth-century church, must be schemed exactly as a glassworker of that period would have designed it. There is a growing feeling in favour of entrusting the design and execution of stained glass windows to artists rather than to manufacturers, and there are, further, striking instances of firms whose work is, much of it, not only adequate but even distinctive and original. The increase of freedom of design, moreover, has led to greater rather than less appreciation of the qualities of glass, and though at times the stained-glass designer—who, it may be, is a painter as well—is led to try for effects which may perhaps be over-pictorial, he does not even then forget the limitations of his material or think that he is increasing the beauty of his work by obscuring the glass with enamel colour.

Mr. Louis Davis's glass for the great choir windows at Dunblane—portions of which have been on view, together with the cartoons, at the Medici Gallery is perhaps rather on the pictorial side, but it is beautifully glassy for all that. The subject chosen was the Benedicite, and it afforded the artist ample opportunity for showing his real feeling and his love of symbolism—and gave him at the same time scope for a beautiful display of colour. The windows as a whole suffered rather from the fact that, owing to their size, they could only be shown in sections, so that it was difficult to realise what would be their effect in position; and, added to that, there was the usual trouble with the light, which made colour gorgeously strong at one hour look almost thin at another; but in spite of all difficulties of exhibition it was easy to see how carefully the colour had been schemed and how well considered was the design. "The green things upon the earth" and the "whales and all that move in the waters" offered a splendid chance, which had been seized and made the most of, for delicate variations of colour, as did also, in a different key, "the ice and snow" and "frost and cold." The red wings of the Seraphim were a gorgeous medley of pot-metal reds, of which the effect was heightened by the happy device of setting the heads an inch or so further back than the rest of the glass. "The Spirits and Souls of the Righteous" and the "Holy and Humble Men of Heart" were very beautifully rendered, whilst the artist's appreciation of the sacramental import of the canticle is very happily conveyed by the introduction of

the Angel of Bread and Wine and the Angel of Baptism and the bird's-eye view of the Heavenly Jerusalem. There is a sincerity and a reverence about Mr. Louis Davis's symbolism which is always delightful. In the Dunblane windows we find these qualities combined with a very real understanding of the glass and the possibilities in the way of colour which it offers. The result is a set of windows of which the artist has every right to be proud.

Hammersmith Arts and Crafts. — Local patriotism in London is a plant of somewhat recent growth, which even to the present day only flourishes in certain localities and, for the most part, in those farthest removed from the centre of town. The days are past, however, when Hammersmith could be considered as on the outskirts of London, and yet the last year has shown that it has a strong corporate life, whilst the recent exhibition at Hampshire House, in Hampshire Hog Lane, has called attention to the fact that the district has for some time past been the centre of a good deal of artistic industry. Everyone knows, of course, that Morris settled in Hammersmith, and that the Doves Bindery and Press have been for many years housed near by. But for the rest, most people have not realised how many of those concerned in art and artistic industry either live or work (or do both) there An exhibition of Hammersmith work, however, which includes bookbinding by Cobden Saunderson; printing by the Kelmscott and the Doves Presses; wood-engraving by the late W. H. Hooper and by Noel Rooke; collotype and letterpress printing by Emery Walker; embroidery by May Morris and the Misses Wright; as well as woodwork by Charles Spooner and Romney Green; metalwork by Edward Spencer and the Artificers' Guild; enamels by Mr. and Mrs. Stabler; and stained glass by Christopher Whall and George Parlby, certainly proves the neighbourhood's right to be considered an important art centre. Nearly all the artistic crafts were represented, and the majority of them in such fashion as redounded to the credit of the exhibitors. No one could go over the quaint old house and look at the exhibits without being convinced both of the value and of the sincerity of the work shown there. The specimen room, furnished throughout with simple hand productions, was artistic without being in the least affected. The tables, the chairs, and the bookcases all suggested usefulness as well as beauty. The only drawback which occurred to the visitor was the price of the exhibits. They were by no means dear for what they were, but they could not, of course, compete in price with machine-made work. They will probably last longer and be cheaper in the end, but that does not decrease the initial cost to the buyer. Many people to whom hand-made furniture and metalwork make a real appeal cannot afford them. There is, perhaps, a still larger class of persons who frankly like change, and therefore are not attracted by the prospect of belongings which will last for ever.

The Hampshire House Club, however, strong in its belief as to the superiority of handwork and of a workshop system which provides different surroundings from those of the ordinary factory, has established dressmaking and wood workshops, and hopes to increase its activities. The shops have not yet had a very long trial, but some of the woodwork turned out was very creditable. The dressmaking and embroidery was a good deal less satisfactory. In view of the excellent work done nowadays by the students in the London trade schools, it seems a little doubtful how far there is scope for ventures of this kind. The Hammersmith people have at least the courage of their convictions, and their woodwork, at any rate, is of a type which deserves to have some success.

Belgian Work at Hammersmith.— Hammersmith's activities are, however, by no means bounded by the production of English work. Side by side with the establishment of what will, it is hoped, be permanent workshops, temporary accommodation has been provided to allow Belgians in this country to follow their own trades. Seven refugees are engaged in woodwork, seven more in bootmaking, and three in embroidery. There was not very much embroidery on view at Hampshire House, and bootmaking can hardly be classed as an artistic craft in the ordinary sense of the term. The woodwork, however, comes under quite a different category. The idea is that it should be sold to Belgians and the proceeds used for repatriation, a plan which is commendable in every way. Of the work itself it is difficult to speak too highly. It does not, of course, as a whole appeal to the prevailing English taste, though the copy of the bench from the town hall at Furnes is an attractive piece of work, and the reproductions of objects at Ypres and Louvain have a certain pathetic interest (apart from their beauty) for Englishmen and Belgians alike; but as the work of Belgians for Belgians it is altogether admirable. The workmanship is sound, the designs good of their kind, and the prices asked reasonable in view of the quality of the work. It is to be hoped that, so long as the workshops are needed, they may meet with the support which they undoubtedly deserve.

GENERAL NOTES.

"Scientific American" Anniversary Number. – The number of the *Scientific American* published on June 5th is a special one — the seventieth anniversary number, the paper having been founded in June, 1845. It contains an interesting

and well-written account of the progress of invention from that year down to the present date. This is given for the most part in ten-year periods, though there are in addition special articles, amongst which are "Transportation on Land and Sea," "The History of the Automobile," "Seventy Years of Civil Engineering," "The Invention and Development of Photography," "Communicating over Great Distances," and "The Patent Office and Invention since 1845." Naturally enough the history is written from an American point of view, and full stress is laid upon the work of American inventors. In some cases, such, for instance, as the invention of the reaping machine, exception might be taken to some of the historical statements. But on the whole the history is very fairly written. For instance, the great question as to the inventor of the telegraph is put fairly enough from the American point of view by saying, "Europeans are not willing to concede to Morse the credit of having invented the telegraph, and Americans are not willing to concede to Europeans the credit of having anticipated Morse." But if full credit is given to Americans, it would by no means be fair to suggest that the great inventors of other countries have been by any means overlooked—Wheatstone, Kelvin, Parsons, Fox Talbot, Marconi, Daguerre, and very many others have their work duly noticed. And only those who have tried their hands at recording the progress of invention in past years know how very difficult it is to ascertain the truth with regard to the early history of almost any invention.

Differential Resonator.—An American Fellow of the Society, Dr. Edward Hunter Murfee, of Brenau College, Gainesville, Georgia, has sent the Society a description of a Differential Resonator invented by himself. The object of the invention is, by means of a tube of adjustable length, to provide an air column of any desired length which will vibrate to a corresponding musical note. The principle on which the instrument works is familiar enough, and it is a well-known experiment to hold a vibrating tuning-fork over a tall vessel, which can be filled up with water until the length of the air column is such that it will take up and reinforce the note given out by the fork. The apparatus consists of a tube fitted with a piston, adjustable by a rack and pinion device. The piston-rod is hollow and terminates in an ear piece. By altering the position of the piston the length of the air column in the tube can be regulated, and its position read. For such purposes as tuning musical instruments, such for instance as a violin, the resonator is set at the point where it responds to a given note, and when the violin string is tuned to give out this note the resonator responds. For detecting musical notes at a distance, the resonator can be adjusted until it responds to the note. There are various other purposes for which the instrument is considered to be available, and for which no doubt it is perfectly well suited.

Dogfish as Food.—Some years ago an article on "The Commercial Uses of the Dogfish" appeared in the *Journal*,* which described three factories then recently established in the United States for converting dogfish into oil and fertilisers. The American Department of Commerce has for some time been investigating the question of using it as a food, and it contemplates making an experimental station at Maine, where the fish will be properly treated and then sent out to the public for food, to see how it is accepted. The Bureau believes that the portions that are not suitable for food might be used for fertilisers, as are the waste parts of other fish; that the skins might be cured for leather, and that such experiments as are necessary might well be made by the Government, by taking over some canning plant or menhaden factory for that purpose. Experiments similar to those proposed for the dogfish have been tried by the Government in regard to the sea mussel, and in Boston a supply was sent to leading hotels and restaurants, and found to meet with excellent favour as a palatable food. The bureau believes it is practically impossible to reduce the number of dogfish by a bounty and rendering works, but hopes they can be turned to a good purpose for food, just as were the halibut and swordfish, which for a long time were looked upon with disfavour, but at last became a prized article of sea food.

Printing Inks.—A great deal of useful information is to be found in "The Composition, Properties, and Testing of Printing Inks," a circular just issued by the Bureau of Standards of the Department of Commerce at Washington. It deals with various oils, pigments, driers, and formulæ for the manufacture of printing inks. The effect of the paper on the ink is also considered: some papers are highly absorbent, in which case the vehicle may be a non-drying oil; while with the coated and non-absorbent papers, such as are used for illustration work, a quickly drying or hardening medium must be used, though it must not dry on the formes or rollers. Actual printing tests under definite conditions are preferred for practically finding the qualities of various inks, because "if the article does all that is required of it, its composition is of minor importance." At the same time analytical tests are obviously useful for ascertaining the causes of trouble in printing, the permanency of pigments, and so forth, and there is apparently room for a considerable extension of such work.

New Tin Smelter in Chile.—A company is being formed in Santiago for the establishment of a tin smelter that would manipulate the raw material obtained from the Bolivian tin mines. The foundry, says the *Review of the River Plate*, would be situated at either Arica or Mejillones.

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FRIDAY, JULY 9, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICE.

SPECIAL WAR LECTURES.

Wednesday afternoon, July 7th; Sir Boverton Redwood, Bt., D.Sc., F.R.S.E., in the chair. Professor Vivian B. Lewes, F.I.C., F.C.S., delivered the first lecture of his course on "Modern Munitions of War." The subject of the lecture was "Guns and Propellants."

The second lecture, which will deal with "Mines, Shells, and High Explosives," will be delivered on Wednesday, July 14th; and the third, dealing with "Poison Gases and Incendiary Bombs," on Wednesday, July 21st, at 4.30 p.m.

The lectures will be printed in the *Journal* during the summer recess.

PROCEEDINGS OF THE SOCIETY.

FOTHERGILL LECTURES.

MOTOR FUELS.

By Professor Vivian B. Lewes, F.I.C., F.C.S.

Lecture I.—Delivered February 15th, 1915.

Two years ago I gave a course of Cantor Lectures in this room in which I dealt with the subject of oil as a fuel, and the enormous demands made upon the fraction of the crude oil that we use as petrol for fuel in our motor vehicles naturally led to my devoting considerable attention to that portion of the subject and the proposals that had been made from time to time to find substitutes which could be made available in sufficient quantity to check the then rapidly rising price of petrol, which threatened to bring disaster to the motor industry. Since then considerable work has been done, and my excuse for choosing motor fuel as the subject for the present lectures is as far as possible to bring the subject up to date and to discuss the directions in which the greatest progress seems possible.

Great as had been the increase in the quantities of petrol imported annually into the United Kingdom between 1905 and 1912, the average increase was only about half of that for the years 1913 and 1914, last year's imports reaching the enormous volume of 120,000,000 gallons in spite of the disturbing influence of the war—a great tribute to the work done by our Fleet in keeping open the seas, most of our supplies coming from the Dutch East Indies and America.

The rate of increase in the demand for petrol is so true an index to the growth of motor traction that it is interesting to tabulate the amount imported during the last ten years:—

Year.	Gallons.	Year.	Gallons.
1905	18,000,000	1910	55,000,000
1906	25,000,000	1911	70,000,000
1907	34,000,000	1912	80,000,000
1908	40,000,000	1913	101,000,000
1909	53,000,000	1914	120,000,000

It is then seen that in the six years since 1908 the use of petrol has been trebled. Moreover we must remember that in the last two years, which have shown the most rapid increase in the consumption of petrol, there has been also a considerable volume of benzol, shale spirit and other substitutes employed, which would probably bring the consumption for each of these two years to another 10,000,000 gallons.

It might be supposed that the increase in quantity during 1914 was dependent largely on the enormous volumes of petrol used in the war for transport, aviation and other purposes, but

this idea is negatived by the fact that up to the middle of August the imports of petrol were 80,000,000 gallons, and therefore no sudden increase in supply has manifested itself due to war demands: whilst it must be remembered also that these quantities do not include the Government supplies, which in 1914 amounted to 170,000,000 gallons, chiefly no doubt fuel oil, but also probably partly petrol. All the French ports have been open for the importation of petrol; and it is known that in October France imported 2,250,000 gallons as against 800,000 in October, 1913, so that probably most of the spirit used at the front went direct into the country.

The titanic struggle which is convulsing Europe and sending its tremors over the whole world has demonstrated to the utmost the importance of the motor in war as giving mobility to the troops and keeping up communications between the base and the front, and large as were Germany's stores of petrol at the commencement of the war, Russia's conquests in Galicia and the cessation of supplies from Roumania have cut off the chief means of replenishing them; the pinch is beginning to be felt, and may indeed play a by no means unimportant part in bringing the war to a conclusion.

Enough petrol must be kept for aviation, and it must be as light a spirit as possible; benzol is dangerous to use owing to its crystallising at low temperatures, so that at great altitudes any failure in the warming of the whole of the feed system by the exhaust might lead to the stoppage of a feed-pipe and bring down the machine, whilst in any case light spirit is needed for priming in starting. The forced economy of petrol is already hampering the transport work in the enemy's lines, and benzol and alcohol are being used as far as possible, but in the carbonisation of a ton of coal in the Westphalian coke ovens two gallons of benzol purified sufficiently for this use would be a liberal estimate, so that the problem of motor fuel is a very real one to the enemy, whilst England and France can get all they need from overseas, and Russia can get her supplies from Baku and the other oil-fields on the Caspian shipped direct up the Volga, whilst if more is needed Galician and Roumanian supplies probably would be available. Germany has devoted more attention than almost any other country to the use of alcohol as a motor fuel, and we know that for some years her postal vans were run with it; but the German alcohol is made mostly from potatoes, and the immense demand on this crop for food leaves none available for fermentation.

The crude petroleum as it comes from the oil-well is taken to the refinery and then undergoes a process of fractional distillation, the most volatile portion coming over below 150° C. being called benzine; and before the demand for motor fuel reached proportions so great as to tax the efforts of the producer to the utmost this fraction was again divided by distillation into spirit for dry-cleaning, petrol and solvent spirit, the petrol having a specific gravity of 0·68, and being so volatile that starting troubles were unknown. Now to meet the demand practically all the benzine is sold as petrol, the specific gravity being about 0·72, with the result that starting from cold on a frosty morning is by no means a simple performance. The amount of this benzine present in the crude oil varies widely with the oil-field, some, like the oils of Sumatra, Borneo, Roumania, Pennsylvania, Kansas and Illinois, containing percentages of from 14 to over 30, whilst the Californian and Texas oils rarely reach 5 per cent.

The chief sources from which our supply has been obtained during the past two years are shown in the following table: —

IMPORTS OF PETROL IN MILLIONS OF GALLONS.

	1913.	
Dutch East Indies	52	
United States .	24	41
Russia . . .	13	10
Roumania . .	6	6
Mexico . . .	1·5	2·5
Other countries .	4·5	3·5
	101·0	120·0

The interesting point about this table is that it shows the enormous increase during the past year in the importation of petrol from the United States, which has made up for the cutting off of the supply from Russia and Roumania since August last, and also that in spite of this the supply from Roumania was so increased during the early months of the year that her total for 1914 is as high as for 1913.

One of the reasons that put up the price of petrol in 1911–12 was the high freights caused by the number of oil tank steamers engaged in

shipping the spirit being inadequate to meet the rapidly increasing demand, and as a result twenty-eight oil-tankers were launched in 1913 from English yards; six of these were of 15,000 tons capacity each, and the total capacity of the new fleet was 250,000 tons. The number of these vessels was added to largely in 1914, with the result that freights have fallen to a point that offers no excuses for inflated prices, and during the last year a reduction was made in the price of the best petrol by one penny a gallon.

Petrol distilled under ordinary conditions from the crude oil consists of a mixture of the first five liquid members of the paraffin series, all of which boil at or below 150° C., and its specific gravity and volatility depend upon the proportions in which these compounds are present.

THE VOLATILE LIQUID PARAFFIN HYDROCARBONS.

	Formula.	Boiling-point.	Specific gravity.
Pentane . .	C_5H_{12}	37°C	0·628
Hexane .	C_6H_{14}	69	0·664
Heptane .	C_7H_{16}	98	0·700
Octane .	C_8H_{18}	125	0·719
Nonane . .	C_9H_{20}	136	0·741

The petrol which was at first imported had a specific gravity of 0·680, and consisted of a mixture of the first three; octane then began to appear in quantity in the spirit, and the specific gravity rose to 0·700; whilst for the last few years nonane has also been present, and the specific gravity has been 0·72 and over. It must not be assumed that all the petrol at present imported consists of these saturated hydrocarbons only, as when we come to discuss the subject of making petrol substitutes by "cracking" heavier grades of petroleum by heat into more volatile ones, we shall find that some of the paraffins, to which series all the above belong, are changed into unsaturated hydrocarbons which, although as volatile, are of a heavier specific gravity, and the demand for petrol has led to many refineries adopting methods of distillation that increase the normal yield at the expense of the heavier portions of the oil, so that it is quite possible to have a petrol of even higher specific gravity than nonane itself, and it is a mistake to suppose that the specific gravity of a motor fuel is any guide to its value. This will be realised when one considers that benzol, which is an excellent motor fuel, has a specific gravity of 0·886, which in a paraffin hydrocarbon would have meant a heavy residual oil of no use as a motor fuel unless used in a Diesel engine.

There is one point, however, on which specific gravity affords useful information, and that is with regard to the weight per gallon, as specific gravity being a comparison of the weight of the liquid with an equal volume of distilled water taken as unity, and as a gallon of distilled water weighs 10 lb., all that has to be done to obtain the number of pounds that go to a gallon of any liquid is to move the decimal point in the figure for specific gravity one place to the right, and the result is the pounds per gallon.

One of the important considerations in comparing the value of motor fuels is the amount of energy that can be stored in the petrol-tank, of which we know the capacity in gallons. On determining the calorific value of various grades of ordinary petrol, the differences between their thermal units are, as a rule, small, as one would expect from the fact that all the series of paraffin hydrocarbons contain hydrogen and carbon in only slightly varying proportions, and as the experimental determination of the calorific value of such highly volatile liquids as petrol is fraught with considerable difficulty, the variations found often reflect this factor rather than any great difference. The average results of experiments, however, in spite of what one would expect from calculation of them, often show a higher calorific value for the lighter grades of spirit, and average out at such figures as—

Specific gravity.	B.Th.U. per lb. net.
0·680	18,900
0·700	18,700
0·720	18,500

which would represent fairly the general trend of determinations, and at first sight might give the impression that the lighter spirit was the more valuable. As gauged, however, by the capacity of the petrol-tank, it is heat units per gallon that interest us, and our figures become—

Specific gravity.		B.Th.U. net per gallon.
0·680	18,900 × 6·8 =	128,520
0·700	18,700 × 7·0 =	130,900
0·720	18,500 × 7·2 =	133,200

And for all practical purposes we may take the ordinary petrols on the market that have a specific gravity round about 0·720 as having

a thermal value per gallon of 132,500 B.Th.U. net and 144,000 gross.

The gross heating value of a fuel is the total heat evolved by the complete oxidation of its combustible constituents, whilst when hydrogen is one of these it burns to water, the vaporisation of which renders latent a portion of the heat evolved, and if the steam escapes with the other products uncondensed this heat is lost with it, and the net calorific value of the fuel is the total heat of combustion minus the latent heat of the water vapour formed.

In the internal combustion engine the water formed by the combustion of the hydrogen of the petrol all escapes as steam, so that it is the net calorific value that is the important factor.

In forming an estimate as to the value of a motor fuel, calorific value is by no means the most important thing to consider, as often it happens that the efficiency of the engine using it may be so increased, owing to the nature of the fuel allowing of high compression or other factors that tend to the better conversion of the heat units into power, that a fuel relatively poor in calorific value may be nearly equal to one of far higher thermal units in actual use.

There is, however, one point that always must be taken into consideration, and that is the vapour tension of a liquid intended for use as a motor fuel, as this governs its power of evaporation, and upon it depend ease in starting from cold and flexibility in running.

A good motor fuel must give off enough vapour at low temperatures to form an explosive mixture in the cylinders of a car that has been standing all night in a cold garage, as if it does not considerable time and much effort have to be expended in working the starting gear, so as to get a sufficient amount of combustion in the cylinder to raise it to the necessary temperature.

A good deal naturally depends on the form of carburettor used; but with any of fairly modern type a good spirit should give no trouble.

We have seen that when a crude oil is distilled the temperature is raised gradually, and that the fraction which comes over up to 150° C. is called "benzine," and contains the most volatile portions of the oil. The next fraction coming over at from 150° to 300° C. is called "kerosene," and forms the ordinary illuminating oil. The lower fraction can be redistilled, and if the specific gravities and vapour tensions of these fractions be taken it will be found that the vapour tension falls as the specific gravity rises, as is shown in the following table obtained from the fractionation of an American oil:—

Specific gravity.	Vapour tension in mm. water at 15° C.
0·650	2,110
0·680	1,185
0·695	930
0·735	410
0·756	125
0·762	85
0·772	40
0·788	15
0·812	0

These figures make it clear that an oil of this last character, having a specific gravity of 0·812 (which would correspond to kerosene or lamp oil), cannot be used alone as a motor spirit, because on a day when the temperature was 15° C. the engine if cold would never start, as no vapour would be given off to make the explosive mixture with air, and not only must vapour be given off but sufficient vapour to make an explosive mixture with the air in the cylinder.

The scientific methods of determining the vapour tension of a liquid upon which its volatility depends would be far too complicated for use by the ordinary observer; but he can form an equally sound judgment as to how far a motor fuel is likely to be satisfactory in starting and flexibility by means of a simple apparatus devised by Sir Boverton Redwood and Captain Thomson, whereby the relative volatility of various spirits could be determined, the object they had in view being the pressure the spirit might develop in a closed vessel on increase of temperature as bearing upon safety in storage and transport.

The apparatus consists of a thick-walled glass tube of small bore, about 30 in. long. The lower end of the tube is turned up and widens into a cylinder, about 6 in. long and 1 in. in diameter, the upper end of which terminates in a short length of glass tube. The long tube is graduated in inches divided into tenths, and the wide cylinder is provided with two marks, the lower corresponding with the zero of the scale and the upper being placed at nine-tenths of the capacity of the cylinder above the lower mark.

In use a short length of stout rubber tubing is wired to the tube at the top of the cylinder so as to cover it entirely and project about ¾ in. above it. Mercury is poured into the cylinder up to the lower mark, and care is taken that the mercury thread in the capillary tube is not broken. Enough of the liquid under test is

poured into the cylinder to fill it well up to the upper mark, and the apparatus is clamped vertically in a vessel of water at 50° F. After sufficient time has elapsed to allow of this temperature being attained by the apparatus and its contents, the level of the liquid is corrected, if necessary, and the rubber tubing is closed by a pinch cock screwed up very firmly just above the top of the glass tube, the open end of the india-rubber tube being further closed by a glass stopper. The whole apparatus is immersed above the top of the rubber tube in water at 50° F. The temperature of the water is raised very slowly by means of a rose burner, and its temperature read by means of a thermometer immersed in it, unequal heating being avoided as far as possible by any form of mechanical stirrer. As the temperature of the water rises the height of the column of mercury in the capillary tube is read off at every 5° F. rise of temperature in the liquid, the heat being so regulated that this rise takes about ten minutes, and is continued to 100° F.

In this way a comparison can be made between the vapour pressures of various suggested substitutes for petrol as long as they are of the same kind of hydrocarbon, as we know that the best petrols on the market, such as Pratt's "Perfection," give only just the necessary starting power on a cold morning, and that anything that gives a vapour pressure less than that will give rise to trouble in starting, the pressure being a very fair measure of the trouble that would be experienced.

In the following table are given the pressures exercised by Pratt's "Perfection," benzol, alcohol, and pentane:—

VAPOUR PRESSURE IN INCHES IN MERCURY.

Temperature °F.	Pentane	Pratt's spirit.	Benzol.	Alcohol.	A.	B.
55	1·4	0·7	·1	·3	·4	1·0
60	2·0	1·4	·7	1·1	1·1	2 6
65	3·8	2·6	1·5	1·8	1·9	4·2
70	5·8	3·6	2·5	2·7	2·8	6·4
75	8·0	4·8	3·5	3·6	3·8	8·9
80	10·4	5·9	4·5	4·7	4·9	10·9
85	13·1	7·1	5·5	5·75	6·2	13·4
90	15·9	8·2	6·4	6·9	7·1	15·6
95	18·9	9·3	7·3	8·0	8·1	17·6
100	22·3	10·5	8·4	9·2	9·0	20·5

Taking the figures in the table, we know by experience that Pratt's spirit with an air temperature of 60° F. starts from cold without any trouble, and so also would the benzol and the two cracked spirits marked A and B, but nothing one could do would make the alcohol start at that temperature, although it is showing a higher vapour pressure than the benzol, and this is due to the percentage of combustible vapour in the mixture in the cylinder that will explode with electrical ignition. In the case of the benzol it needs only 2·7 per cent. of vapour to give explosion, whilst with alcohol there must be at least 4 per cent., so that although its vapour pressure is higher than that of benzol it does not vaporise sufficiently quickly to reach the larger proportion of vapour needed.

When petrol or other combustible vapours are mixed with air the maximum of chemical action—that is, the complete oxidation of the carbon and hydrogen of the combustible into carbon-dioxide and water vapour gives the greatest energy of explosion. This point is a fixed and unalterable ratio of the vapour to air, and varies only with variation in the composition of the combustible body. On each side, however, of the percentage of vapour that gives the maximum effect there is a range over which the mixture is still explosive, although gradually diminishing in power the further the percentage of vapour is from the correct mixture, until points are reached above and below which the mixture is non-explosive.

The percentage over which the mixture is explosive is called the "explosive range," and varies slightly according to the method of ignition, and figures that have been given for electrical ignition are:—

EXPLOSIVE RANGE OF AIR-VAPOUR MIXTURES WITH ELECTRICAL IGNITION.

Acetylene	3·2 to 52·2	per cent.	range	49	per cent.
Ethylene	4·2 to 14·5	,,	,,	10 3	,,
Alcohol	4·0 to 13·6	,,	,,	9 6	,,
Ether	2·9 to 7·5	,,	,,	4·6	,,
Benzol	2·7 to 6·3	,,	,,	3·6	,,
Petrol	2·5 to 4·8	,,	,,	2·3	,,

although when ignited by a flame a still smaller proportion is combustible with explosion.

It is quite evident that the wider the range over which the spirit employed will form an explosive mixture, the more elastic will be the proportion of air, and we all know the trouble caused when a sudden change in heavy traffic stops the engine by throwing the mixture outside the explosive limits.

Another test which it is essential to make

with a motor spirit is a fractional distillation, in order to ascertain the proportion of hydrocarbons present in it vaporising at a sufficiently low temperature to ensure a complete combustion in the cylinder, and with spirit of the ordinary character 90 per cent. ought to distil over below 150° C.; but it must be remembered that this does not always apply to petrol substitutes.

In carrying out a fractional distillation of this character great care has to be exercised in standardising the method to be employed, as the results found by various observers in a fractionation of the same spirit differ widely, unless the same method of procedure and apparatus are adopted. Probably the most satisfactory method is to take a short-necked Jena glass flask, into the neck of which is fitted a five-bulb Young dephlegmator, in the top of which is placed a thermometer so arranged that the bulb is just below the level of the side tube. A uniform rate of distillation throughout the run must be maintained, and the temperature is noted at which the first drop leaves the end of the side tube. From that moment the volume collected through each 10 cc. should be noted, and the distillation carried up to 150° C., unless the bulk of the liquid has passed over below that temperature.

When distilling mixtures such as are to be found in some petrol substitutes, the distillation results, if plotted out, will generally give a very good idea of what the constituents are, which can be confirmed by taking the specific gravities of the main fractions. In the following table the fractionation of Pratt's spirit is shown as an example of a true petrol:—

FRACTIONATION OF PRATT'S SPIRIT.

Specific gravity	0·7088	
First drop	30°C.	
Below 50°C.	1·50	per cent.
,, 60°	7·25	,,
,, 70°	19·25	,,
,, 80°	28·75	,,
,, 90°	42·25	,,
,, 100°	57·25	,,
,, 110°	70·25	,,
,, 120°	79·50	,,
,, 130°	86·50	,,
,, 140°	91·00	,,

It must, however, be clearly grasped that in many petrol substitutes it is possible to use mixtures in which some fractions distil as high as 250° C. if sufficient spirit distilling below 100° C. is present to give ease in starting and the necessary flexibility in working.

When petrol was first introduced it seemed probable that its high volatility, and the fact that the vapour it gave off was highly inflammable and formed a violently explosive mixture when mixed with air, might threaten its use, but experience has shown that the accidents due to it have not been nearly so numerous as it was feared they might be. One knows from experience that on a warm summer's day the vapour comes off so rapidly that a tin left open soon undergoes a serious diminution in volume, and that the spirit has such a wonderful penetrative power, and is so liable to creep, that the smallest fault in a screw-cap or plug leads to a slight leakage, with the result that in places where the petrol is stored slight leakage and evaporation into the air are constantly occurring, and as 2½ per cent. of the vapour in the air forms an explosive mixture of maximum strength, whilst 1·6 per cent. is still explosive when ignited by flame, strict precautions should be taken to protect such places from becoming an active source of danger. Probably the factor which gives the greatest danger is that the weight of the petrol vapour is so far above that of air that it spreads and flows over a flat surface in much the same way that a liquid would do, and as a pint of it poured on the floor will give sufficient vapour to cover 80 sq. ft. with inflammable vapour to a sufficient thickness if ignited at any point to carry the flame back to the point of leakage, it is clear that the floor level is the one which should be specially considered in precautions to minimise danger, and a strong floor draught is one of the most important factors of safety that can be provided.

The reason why so few accidents happened in the past is due to the high temperature needed to ignite the vapour either alone or mixed with air, and a long series of experiments made by Sir Boverton Redwood, Colonel Majendie, and Dr. Dupré in the early days of the use of petrol showed that the vapour could not be ignited by the glowing spark on a splint of wood, a red-hot piece of coke, or a shower of sparks from a flint and steel; and from experiments which I have made since I think we may safely assume that the ignition point is in the neighbourhood of 1,200° C., and it is this which has safeguarded its use. How often have we seen the careless chauffeur filling the tank of his car with spirit whilst at the same time smoking a cigarette, a proceeding which, had the igniting point been as low as that of any ordinary combustible, such as paper, wood or coal, would have led to disaster.

The necessary temperature to cause ignition,

although never reached by a glowing body, is attained with the smallest of flames, the temperatures of which are practically all higher than 1,200° C., and the throwing down of a lighted match on a surface over which petrol vapour is flowing has caused many serious fires.

The high ignition point of the explosive mixture of petrol and air also explains the necessity for a higher density spark for igniting the mixture in the cylinder.

The volume of vapour yielded by a sample of petrol depends upon its composition, the variation which exists between the various constituents being shown in the following table:—

VOLUME OF VAPOUR FROM PETROL HYDROCARBONS.

	Specific gravity	Boiling-point.	Cubic feet of vapour. Per gall.	Per lb.
Pentane . .	·626	37·6°C	31·2	4·9
Hexane . .	·664	69°	27·7	4·1
Heptane .	·700	98°	25·7	3·7
Octane . .	·719	118°	22·6	3·1
Nonane . .	·741	136	20·8	22·9

So that the higher the specific gravity the lower will be the gas yield.

In considering the price of petrol we must not lose sight of the enormous amount of handling which it has to undergo from its distillation and rectification until it reaches the consumer. It has to be piped down from the refinery to the port, run into the big tank steamers which bring it to the English ports, and there it has to be unloaded into store; all of which operations with a highly volatile liquid like petrol give rise to a certain amount of loss, and the transport is rendered more costly by the regulations laid down to ensure safety, whilst the tank steamers have to be of special type, and its handling from the moment it reaches this country is hedged around with regulations.

The chief distributing ports in England to which petrol is brought are Thames Haven, Bristol (Avonmouth), Barrow, Manchester, Liverpool, Hull, Sunderland, Cardiff, Plymouth and Southampton, the Thames Haven stores being the most important in the world. And it is here that all the petrol for London and the south-east district is landed, as tank steamers are not allowed higher up the Thames.

At Thames Haven the tank steamers come alongside the deep-water wharves, and the cargo is pumped into great storage tanks, of which there are now over 100, many of them holding 4,000 tons each. The ground occupied has a river frontage of over a mile in length, with a varying depth, two-thirds of which is taken up with the storage tanks. The whole is fitted with a unique arrangement of pipes and pumps, by which the discharging of the cargoes into the storage tanks and from the tanks to the barges, and the various canning and barrelling departments, is carried out, all the pipes being led to an exchange building, at which connection to the loading and unloading piers, the tanks and the various departments can be effected, so that the contents of any tank can be transferred to another or to a pier line or canning department at will—an arrangement which gives absolute control over the whole storage, and allows the handling of the oil to be carried out with the minimum of loss and labour.

From Thames Haven the petrol is distributed either by rail in tins or drums or in bulk by barge to the London stores of the various big companies, at which again elaborate precautions have to be made to ensure safety, and here if canned it has to be distributed to the retailer. The cost of storage and distribution from Thames Haven has been given by Sir Marcus Samuel as 5*d*. per gallon, and the tax amounts to another 3*d*.; so that it is seen that the price of the spirit has been inflated largely by these charges, and that its cost at the point of production must be very low in order to admit of the large profits which undoubtedly are made, and it is these extra charges for distribution which are often forgotten or insufficiently allowed for in considering the price at which various motor substitutes can be sold, and also the influence which any large increase in the cost of freight must have upon the price of the spirit, a factor which was undoubtedly an important one in the rises that took place three years ago.

SCIENTIFIC AGRICULTURE IN BENGAL.

Perhaps no province in India is more suitable in every respect for agricultural experiment and research than Bengal, with its great variety of soils, its damp, hot climate, and its rich deltaic areas. The annual reports of the expert officers of the Bengal Department of Agriculture for the year ending June 30th, 1914, testify to this. The chief points are summarised in the *Pioneer Mail*. Three of the most important crops of India are rice, jute, and sugar-cane. All of these flourish in Bengal, and have throughout the year been made the subject of special study by the economic botanist, the fibre expert, the agricultural

chemist, and the Imperial mycologist. In view of the great progress made in recent years in the development of the Agricultural Department, it is curious to recollect that a short decade ago none of the provinces had an Agricultural Department at all. It was in 1904 that Lord Curzon, with the help of Sir Denzil Ibbetson, took up the question of the thorough reorganisation of the department for the whole of India, which resulted in the establishment of the Imperial Agricultural College and Research Institute of Pusa, and later on of special departments and colleges for the Provinces. How necessary this action was the result has proved. Already great benefits have accrued to agriculture, and the opportunities of the future seem almost inexhaustible.

In Bengal there is a system of agricultural stations or demonstration farms, each farm being under a special superintendent of its own, where important experiments are carried out under adequate supervision It is at these agricultural stations that the fibre expert, the agricultural chemist, and the economic botanist are able to test the theories of the laboratory. There are now agricultural stations or farms at Dacca, Chinsura, Rajshahi, Burirhat, Rangpur, Burdwan, Kalimpong, and Chittagong; so that practically all the divisions of Bengal are represented.

The fibre expert has his headquarters at Dacca, the centre of the flourishing jute trade of Eastern Bengal. Very interesting experiments have been made with regard to manures for jute on red acid soils in Bengal. These manurial experiments were begun in 1911, and the results now obtained confirm those of the previous years in a very convincing manner. The lime applied in 1912 gave an increase of 4 maunds per acre of fibre over the unlimed plots: and in 1913 the same plots without any further application of lime yielded nearly 5 maunds per acre more fibre than the unlimed ones. This shows the great value of lime as a manure on such soils. In addition to this, the fibre expert, Mr. Meggitt, is investigating the effects of various forms of phosphoric acid on both limed and unlimed land. "There seems to be no doubt that the action of phosphates benefits jute to a considerable extent; and there is at least some indication that their application actually tends to increase the percentage fibre-content of the plant --a most important matter. There are also indications of their action in other directions; but further work is required, not only on these points, but also as regards the form of phosphates whose application is most advantageous." How important these investigations are likely to be in their effect upon the production of jute may be gauged by the fact that in three years an aggregate expenditure of Rs. 47 per acre on lime and bone has increased the aggregate yield of jute and mustard on the Dacca plots to the value of no less than Rs. 144, representing an increased net return of Rs. 97 per acre. If a more extensive test corroborates the truth of these inferences, the fibre expert will have great cause for congratulation on the results.

Turning to the report of the economic botanist, Mr. G. P. Hector, we find that special attention was paid to the main food crop of Bengal, namely rice. The Ufra paddy disease is very common in Bengal, and very deadly in its effects on the rice crop. Experiments have been made to test the effect of thorough ploughing and stubble-burning during the cold dry months, and these experiments are being carried on in consultation with Dr. Butler, the Pusa expert. There is good ground for hope that they may supply a remedy for Ufra disease, and it is proposed to extend the tests at Comilla under as careful control as possible. With regard to sugar-cane, some valuable work has been done by Mr. Annett, Agricultural Chemist to the Government of Bengal. Five varieties of sugar-cane were tried on the Dacca farm with the object of finding out the most suitable varieties for distribution to cultivators. The results obtained show that the method of sampling recommended by Dr. Leather, Imperial Agricultural Chemist, gives extremely happy results. This method will be followed in future years, and will result in much saving of time in the chemical control of sugar-cane experiments.

GERMANY'S CHIEF COLONY.

Trade of East Africa for 1912-13.

It is early to predict what the future of Germany's colonial possessions may be at the close of the war, but special interest attaches to the report on the trade, commerce, and economic position of German East Africa, which, owing to its peculiarly exposed situation, seems almost to invite annexation at no very distant date. The trade of the colony in 1912 showed an upward tendency in satisfactory proportion to the general improvement in most economic directions. The white population increased by 470, the area under cultivation by Europeans increased from 217,060 acres in 1911 to 312,422 acres in 1912, and to 407,612 acres in 1913, and considerable progress was made in the development of native agriculture. The railway from Tanga on the coast to Moschi at the foot of the mountain peak, Kilimanjaro, was thrown open to general traffic, and the Great Central Railway from Dar-es-Salaam, on the coast south of Zanzibar, to the terminus of Kigoma, on the eastern shore of Lake Tanganyika, was completed on February 2nd, 1914, and great hopes are entertained for the expansion of the Protectorate's trade in the future from the extension of the railways, as there are still large tracts of thickly-populated and fertile land which await opening up by the introduction of adequate means of transport.

The planters complain that there are too many officials, that they are overburdened with troublesome regulations, and that the Government does not supply them with the workpeople they require. The high tariffs on the railways are a source of

constant and loud complaints from planters, merchants, and farmers, and a sympathetic echo is heard in many official quarters. The value of the total imports amounted to £2,515,455 in the year 1912, and shows an increase of 9·6 per cent. over those of the previous year. By far the greater part of these come in through the coast ports, while rather more than a tenth part enter by the overland routes, chiefly *via* the Uganda Railway and the Victoria Nyanza. The total value of the exports in 1912 was £1,570,915, of which 40 per cent. form the increase over the figures for the preceding year.

The principal ports on the coast are the capital, Dar-es-Salaam, and Tanga, and the value of the trade of the first-named was £1,615,000 in 1912, against £1,310,000 in the previous year. The trade of the ports on Lake Victoria Nyanza showed good development, and complaints were heard in 1912 that neither the steamers on the lake nor the Uganda Railway were able to cope with the volume of the traffic. As regards openings for British trade, it is noticeable that the European population increases but slowly, and up to 1914 was largely composed of Germans. It is therefore to be expected that the imports of goods for European consumption will not increase very rapidly, and that they will be for the most part of German origin to suit local tastes. But the trade in articles for the native market is capable of enormous expansion, and there seems no reason why imports of British goods should not increase very considerably. The Indian community, which has increased by some 4,000 in the last six years, is regarded with extreme dislike by the majority of the white population, and, to judge by the attitude of the Indians themselves, is not invariably accorded a sympathetic treatment by the authorities. As a matter of fact, the Indian is a useful, if not an indispensable, member of the community. He is a pioneer of trade, a clever clerk, and a skilled mechanic. He carries on work which the native is incompetent to perform, and he can do so under conditions of life and with an amount of food and capital which would be utterly impossible for a European.

The Central Railway line, which runs from Dar-es-Salaam to Lake Tanganyika, a distance of 780 miles, was begun in 1905, and reached the lake at Kigoma, near Ujiji, in February, 1914. This will become the main artery of traffic, with branch lines to the north-west, and possibly to the south-west (Lake Nyassa region), and will play a most important part in the development of the trade of the Protectorate and in opening up the Tanganyika district. The great lake appears to be regarded as the key to the trade of Central Africa, and the energy with which the rail has been pushed on enables one to travel in two days and two nights from the coast at Dar-es-Salaam to the lake, a journey which the caravans used to take sixty days in accomplishing. When the short stretch of line of about 170 miles, between Lukuga on Tanganyika and Kabola on the Congo, is completed, it will be possible to travel across Africa, from Dar-es-Salaam to Boma, in about three weeks by rail and steamer, if direct connection at each stage is assured. It is also hoped that the Central line will ultimately handle much of the traffic to and from the eastern portion of the Congo and North Rhodesia.

The area under rubber cultivation in German East Africa increased from 81,705 to 112,257 acres in 1912, and the amount of rubber previously exported with a value of £180,000 doubled that quantity in the same year. A large assortment of equatorial products, including among others cotton, sugar, oil-producing plants, wax, cereals, rice, coffee, tobacco, ivory, and reserves of valuable woods, bid fair to develop to a considerable extent.

TIMBER IN BRITISH NORTH BORNEO.

The Government of British North Borneo is taking steps for a general survey of the timber possibilities of the country, and, for the purpose of estimating the amount available and classifying it into the various kinds suitable for export, Mr. D. M. Matthews, an American forestry expert, formerly in the Forestry Service of the Philippines, has been employed.

According to a report by the United States Consul at Sandakan, Mr. Matthews began his duties in December, 1914, and is now proceeding with the work of classification. It may be said that the entire surface of British North Borneo is covered with forests. On account of the dense vegetable growths of all kinds in the tropics, the word "forest" is seldom used; instead, the word "jungle" is commonly applied.

Large Trees—Rare Hardwoods.

In British North Borneo, however, all that part lying back from the coast, except along the rivers, is covered with forest and not jungle. The trees are large, and the undergrowth of vegetation is not so great as in the low-lying country and in the swamps along the coast. The entire coast-line is an unbroken jungle of nipa palms and mangrove trees, but the higher ground is covered with many kinds of forest trees, particularly rare hardwoods, which it is the intention to convert into timber for export. These hardwoods are of many kinds, and can be used for many purposes

A peculiar feature of several best-known woods is the dual formation—a soft outside of a few inches covering a heart of hardwood, usually black. Several trees have sand-coloured and reddish woods—very similar to the so-called California redwood.

The most valuable of all Borneo timber is billian, or ironwood. This is an extremely hard timber, sand-coloured when newly cut, but it darkens with age. It is so heavy that it sinks in water, and for that reason cannot be rafted down the rivers. About 2 inches of the outside of the tree is soft and worthless, but the inside can be used for

almost any practical purpose where a strong, solid, and durable wood is required. It is particularly in request for building purposes in the tropics because it is ant-proof. For all purposes for which heavy hardwood is preferred, such as cabinet or furniture making, dancing-floors, inside finishing of railway carriages, timber for vehicles, etc., billian is admirably adapted. The only objection is its great weight; but that is counterbalanced by its great strength. It takes a fine polish, and is not affected by the elements. It is comparatively plentiful all over Borneo, though the supply immediately around Sandakan is getting short, as many shiploads go to China every year.

Russak and Sirayah.

Another valuable hardwood is russak or selangan batu. This is a dark sand colour and has many of the properties of billian wood, though it is not so heavy nor does it take so high a polish. Billian is more like reddish-brown ebony, if the description may be allowed. Russak is used for general building purposes, but is preferred for posts and piles for wharves, beams for houses, and all kinds of heavy framework. It is an admirable wood for interior finish in halls and churches for wainscoating and panel woodwork. The supply is practically unlimited.

The next common timber is sirayah, or redwood, a comparatively soft wood, very similar to California redwood. Sirayah putch i, a white wood closely resembling American yellow pine. Sirayah proper is so easily worked that it is in very common use. For all building purposes which do not require hardwood sirayah is in great demand: it has even been used for making railway coaches, as several shiploads went to Australia for that purpose. It takes a pretty polish, and is not readily attacked by white ants, though borers seem to thrive on it.

Urat Mata and Greeting.

A very valuable timber is known by the local name of urat mata. It is a dark-red colour, grained, not dissimilar to American mahogany, and much desired for shipbuilding, masts, and planks. It is very durable, and impervious to ants and other insects. The Malays prefer this wood for the bottoms of their boats. It is not so plentiful as billian and sirayah, but can be had in shiploads on a month's notice.

Greeting is a wood closely resembling Indian ebony, though the black inside is sometimes relieved by streaks of brown or red. It grows near the shore and on the edge of swamps, and is very durable both in and out of water. It may be used for all fancy and decorative purposes, including furniture, though it is almost as heavy as billian. Greeting is a good imitation of English black oak, and might even take the place of walnut. In a new country it is the first wood to disappear.

Rungas and other Valuable Timber.

Another wood similar in texture and grain to greeting is rungas, a dark-red wood with a black stain. The heart is a beautiful dark red. Two or three inches of the outside are soft and worthless, but the inside has all the qualities of the most desirable hardwood. It is durable, impregnable to insects or the elements, and takes a high polish. It is not so heavy as billian or urat mata, as it floats. This wood is not found in forests, but grows as isolated trees. It is found all over Borneo.

Other timbers valuable to the export trade are camphor wood, mirabow, and chindana. These woods all have a more or less agreeable scent, and are fine-grained and durable. They are in great demand in Hong-Kong for the inside finish of wardrobes, chests, bureaus, and all wooden furniture intended to contain clothing. These woods are also adapted for fine building purposes and furniture. In the tropics they are used for stairways, doors, window-frames, and finishing work generally.

Imitation Ebony.

The woods described are those in demand for export purposes. There are many other kinds which partake more of the nature of the balsam, white pine, and other softer woods of America. These have not been referred to, with the exception of sirayah, for the reason that they would not be of interest to anyone outside the country. The only other tree that might be mentioned is an imitation ebony. It is another of the woods that has a soft outside and a hard inside. The inside is black, and to all outward appearances is the same as ebony. It is exported to China, where it is used for veneering and inlaying purposes. Sometimes it is made into furniture.

Lumbering Cost.

The cost of procuring timber is not great. The system in vogue near Sandakan is to fell the timber, using Chinese coolies, and raft it down rivers to the bay, where it is loaded into lighters, which go alongside the big steamers and discharge.

It is claimed that the supply of nearly all kinds of timber in British North Borneo will last hundreds of years. Mr. Matthews is not expected to make a report of his investigation for several months; but, as the entire surface of the country is covered with forests, he will no doubt declare the supply practically inexhaustible. At present two companies only are engaged in the export timber trade. The entire supply goes to Hong-Kong.

KAURI GUM IN NEW ZEALAND.

In 1914 a Commission was appointed by the Governor of New Zealand to inspect and classify the kauri gum reserves in the Land District of Auckland, and in particular to ascertain (*a*) which reserves contain or yield sufficient gum to justify their retention as reserves, and (*b*) which reserves are sufficiently exhausted of gum to justify the removal of the reservation

and the opening of the land for settlement purposes.

The report of this Commission has now been issued, and is entitled "Kauri Gum Reserves in the Auckland Land District."

The work of the Commission involved the inspection of 160 reserves, representing a total area of 228,000 acres, scattered over a wide expanse of country extending from Te Kao, near the North Cape, as far south as Katikati, in the Bay of Plenty.

Brief descriptions are given of the kauri gum lands of the northern peninsula, together with a short account of the origin of the reserves.

In the early days of settlement in New Zealand the industry was carried on chiefly by the pioneer settlers and small farmers, and by a steadily-increasing stream of immigrants from South-Eastern Europe. The latter engaged in gum digging as their regular occupation over the vast areas of unoccupied Crown and other lands, which were then of little value. This influx resulted in an over-production of kauri gum, and a slump in the industry followed, which was very keenly felt by the small settlers and original gum diggers. In 1898, in order to protect the interests of the pioneer gum diggers, and to some extent to check this influx, the Kauri Gum Industry Act was passed. As a result, gum reserves were established, and all gum diggers were required to pay an annual licence fee amounting to 5s. in the case of British subjects, and £1 (later increased to £2) in the case of aliens. From the passing of this Act up to the present time a total area of 276,210 acres has been set apart as reserves, of which certain areas, amounting in all to 48,849 acres, have been withdrawn from reservation for various reasons. Most of the land so withdrawn has been selected for settlement.

The total area of the gum-bearing lands (which are all in the Auckland Provincial District) was estimated in 1898 at 814,000 acres. Of this area 435,000 acres were then Crown lands, the balance being represented by privately-owned lands and native lands which had not been adjudicated on by the Native Land Courts. Prior to 1898 there were no restrictions of any kind on the gum diggers. Since that date a certain amount of protective legislation has been introduced, but up to the present time no attempt has been made to prevent gum land from being rendered useless for farming purposes. As a result, the gum diggers have wandered at will over the Crown lands, digging holes varying in depth from 3 ft. to 15 ft., which they are not under any obligation to fill in; in some cases there are as many as two hundred of such holes to the acre. In addition, the vegetation growing on the lands has been fired year by year by the diggers, and at all seasons. The effect of these successive fires has been to destroy the humus and surface soils, together with gum deposits of very considerable value, while in the case of many peat flats and swamps the fires have gutted them almost to the water level. In contrast to this state of affairs instances are given of private owners who have drained their land and let the gum-digging rights at a substantial royalty on condition that any holes made should be filled in, and all roots, stumps, etc., met with should be thrown up on the surface of the ground, leaving the land in a suitable condition for farming purposes. The Commissioners consider that the proper development of the Crown gum lands, under judicious management along the lines above described, would solve the "unemployed" difficulty for many years to come. The work should prove self-supporting, and the land would be left in a condition suitable for farming. Experiments have shown that gum lands, after breaking in, are suitable for general farming, and certain areas are considered to be well adapted for fruit-growing and for afforestation purposes. It is recommended that the lands should be developed by the State before being offered for selection, as the settlement of the gum lands by men possessing little or no capital would probably prove a lengthy process.

The Commissioners recommend that the reservation be removed from various kauri gum reserves of a total area of 71,164 acres. A schedule of the individual reserves is given. They are also of opinion that immediate steps should be taken to check the advance of a sand drift which threatens to overwhelm an area of 300,000 acres on the peninsula north of Ahipara. Of this area 100,000 acres are Crown lands, including gum reserves. A brief account is also given of the importance and value of the kauri gum industry. The Commissioners conclude the report by recommending that a small Department should be created to take charge of the Crown gum lands and the kauri gum industry generally, such a Department to be made self-supporting by imposing an export duty of £1 per ton on kauri gum.

According to the *Chemist and Druggist*, a Bill amending the law in regard to the kauri gum industry in New Zealand was passed in October, 1914. The Prime Minister of New Zealand, in moving the second reading, stated that soon after the outbreak of war gum became unsaleable, and several thousands of men were threatened with unemployment. To obviate this Parliament was asked by the Government for £50,000 to make advances on gum to the extent of not more than 50 per cent. of its value. The kauri would be taken possession of by Government representatives and stored till the market improved. In normal times a large proportion of the gum was exported to Germany for use in the manufacture of varnishes and linoleum. Since the outbreak of war the

demand from the United Kingdom has fallen off, but that of the United States was still being maintained. The Premier also stated that the Government intended to work the gum-bearing lands along the lines suggested in the report of the Commission referred to above, and it was thought that the gum thus obtained would realise more than sufficient to pay the men the current rate of wages.

THE MOLASSES PROBLEM IN CUBA.

An important paper by Mr. Noël Deerr on the Cuban sugar industry is reproduced in the latest issue of the *West Indian Bulletin* (the official organ of the Department of Agriculture of the West Indies), and includes the following observations on the molasses problem in that country. Mr. Deerr argues that the price obtained normally for molasses is not reasonably high enough if one works out the value of molasses on the basis of its industrial potentialities, which include the manufacture of alcohol, potash (both very important just now), and nitrogen. To these might be added the utilisation of molasses directly on a large scale in pig-raising, and its employment in the manufacture of acetone, used in the preparation of explosives. Mr. Deerr says:—

"Connected intimately with the well-being of the cane-sugar industry in Cuba is the molasses problem. At the present moment the molasses production in the 178 factories in Cuba is sold at rates varying from 2½ to 4 cents per gallon, and this may, on an average, be estimated to give the sellers a profit of one cent per gallon. I do not think this profit is reasonable, and I particularly wish to place before you the facts as to the molasses annually produced in Cuba.

"For the crop of 1913–14, the sugar production of Cuba was very nearly 2,600,000 tons: at a low estimate this must have produced 40 gallons of molasses per ton of sugar, or, in all, 100,000,000 gallons of molasses. With the most modern processes of fermenting and distillation, these 100,000,000 gallons of molasses could have produced 40,000,000 gallons of commercial alcohol; in actual practice at the present time, as a source of power, alcohol is worth, bulk for bulk, 60 per cent. of gasoline; these 40,000,000 gallons of alcohol would thus be equivalent to 24,000,000 gallons of gasoline, worth 36 cents per gallon, or a total of $8,640,000. This would give to alcohol a value of 23 cents per gallon, and enable it to compete with gasoline.

"In addition to the sugar in the molasses, a very great proportion of the potash removed from soil by the crop of cane is to be found in the molasses. I have not available any analysis of Cuban molasses showing the percentage of potash, but in all probability this will not be below 3 per cent. The 100,000,000 gallons produced for the crop of 1913–14 in Cuba will weigh in all 600,000 tons, so that this molasses will contain 18,000 tons of potash. The present price of sulphate of potash in Cuba is $55 per ton, which would give to the potash a value of $110 per ton. The 18,000 tons of potash contained in the molasses have, then, a value at the current price of $1,980,000.

"In addition to the potash, molasses contains a small but very appreciable quantity of nitrogen, which I will, in the absence of detailed analysis of Cuban molasses, take as being 0·5 per cent.; then there is contained in the molasses, 3,000 tons of nitrogen, having a market value of $1,200,000 when valued as a commercial fertiliser.

"In addition there is a small quantity of phosphoric acid in molasses, which will not be taken into account.

"The following tabulated statement gives the gross value of the three principal products of the molasses output, based on a production of 2,500,000 tons of sugar:—

Alcohol, 40,000,000 gallons, worth 20 cents a gallon	$8,000,000
Potash, 18,000 tons, worth $110 a ton	1,980,000
Nitrogen, 3,000 tons, worth $400 a ton	1,200,000
	$11,180,000

"It is one thing to make a calculation showing the possible value of the products to be obtained from the molasses produced annually in Cuba, but before these can easily be realised it is necessary to demonstrate the possibility of a market for them. I believe that a very extended use for the alcohol capable of being produced locally can be found within the limits of the sugar plantation in the following cases:—

"(a) Alcohol-burning locomotives;

"(b) Alcohol-burning tractors, to be used in propelling ploughs, cultivators, and other agricultural implements.

"The 18,000 tons of potash contained in the molasses produced annually in Cuba are several times more than the quantity imported annually into Cuba for use as a fertiliser, which amounts at present to about 3,000 tons. I am informed that great difficulty would arise in the marketing of this product, since the world's supply of potash is controlled by a German syndicate prepared to crush any competition; this monopoly of potash is keenly resented in the United States, where any source of supply would be eagerly welcomed, and where we should have to look for a market.

"I would, in addition, point out to you that the recovery of alcohol, potash, and nitrogen from the molasses presents no technical difficulties, as many plants on the Continent of Europe already work up beet molasses. The process is simple, and the plant not expensive; I estimate that ten centralised distilleries,

established at different points in Cuba, could be erected for a capital cost of, say, $1,800,000, and that these would be capable of treating the whole molasses output of Cuba.

"The one outstanding trouble in Cuba is shortage of labour. The increase of the capacity of a limit of labour through the medium of mechanical appliances will always be of great benefit to a community such as exists in Cuba. A cheap source of power, at present almost wholly unutilised, is available, and I believe that it would be greatly to the advantage of the Republic."

COTTON MILLS IN CHINA.

The cotton-manufacturing industry in China did not enjoy the same degree of prosperity in 1914 as in the preceding year. During 1913 the mills ran on full time through the greater part of the year, there was a strong demand for yarn at good prices, and the results of the operation of the mills were highly satisfactory. Some of the foreign-managed mills made net profits of 30 or 40 per cent. of their capital. In the early part of 1914 the prosperity of the preceding year continued; but the stagnation in general trading circles and the curtailment of the country's exports of native produce, following the outbreak of the European war, seriously affected the local mills. The demand for cloth and yarn fell off considerably, and production was somewhat curtailed. At present, however, nearly all the mills are operating their spindles night and day; those that have weaving departments are running their looms in the daytime only.

Fairly Good Year for Mills—Growing Use of Chinese Yarn.

In spite of the adverse conditions in 1914 the mills had a fairly prosperous year, and those under foreign management, with one exception, declared dividends only slightly less than in 1913. According to a report by the United States Commercial Agent at Shanghai, the year 1914 was notable for the degree to which yarn made in Chinese mills displaced Japanese and Indian yarn. For the first time the deliveries of Chinese yarn in Shanghai exceeded those of foreign spinnings. The actual deliveries at Shanghai of Shanghai, Japanese and Indian yarn were as follows: Shanghai, 56,752,000 lb. in 1913 and 77,850,133 lb. in 1914; Japanese, 59,687,066 lb. in 1913 and 66,727,333 lb. in 1914; Indian, 78,902,666 lb. in 1913 and 68,839,600 lb. in 1914.

As Shanghai is the most important market in China for the sale of yarn by importers to dealers in all parts of the country, these figures indicate the extent to which the local mills have been able to compete with yarns purchased abroad. India furnishes counts 10, 12, 16 and 20; Japan, 16 and 20; while the mills in China make mainly 10, 12, 14, and a small quantity of 16 and 20.

Production of Chinese Mills.

The total annual production of the mills in China is 200,000,000 to 250,000,000 lb. of yarn and 40,000,000 to 50,000,000 yards of cloth; during 1915, if the mills operate on full time, the yarn production will doubtless reach 300,000,000 lb., owing to the increase in the number of spindles during the past few months. The weaving industry is still in its infancy, but is gradually being developed. The principal kinds of cloth woven are 36 in., 48.48; 2.50, 2.85 and 3.00 yard grey sheeting, and 30 in., 68.44 or 68.48, 2.85 and 3.00 yard drills. One of the mills in Shanghai has recently begun to weave Canton flannels, and the goods have sold very well in the market.

Cotton Mill Statistics—Raw Cotton—Success of Cotton Mills.

There is no organisation among the Chinese cotton mills and there are no Government industrial statistics; but figures compiled by a Shanghai firm and believed to be approximately correct show that there are thirty-two cotton mills in China with 1,009,856 spindles and 4,610 looms. During 1914 about 100,000 were added to existing mills and several new plants were launched, but are not yet in operation. Although the total number of spindles is not large, it must be remembered that practically all the mills run day and night on a 23-hour schedule.

The bulk of the raw cotton consumed in the mills in the country is Chinese, which is only three-fourths to seven-eighths of an inch in staple and more harsh than American; it is fairly suitable, however, for spinning low counts. For making Nos. 16 and 20, Indian and American cotton is mixed with the locally grown staple. The present price of the best quality of Chinese cotton in Shanghai is 3½*d*. to 4*d*. per lb.

A supply of raw material, an abundance of extremely cheap labour, with no restrictions as to the hours of work or the employment of children, and a large domestic market for yarn and cloth, are the chief factors in the success of the Chinese cotton industry. It has already passed the experimental stage, and all indications point to further development in the next few years.

PANAMA HAT INDUSTRY IN COLOMBIA.

Toquilla straw, from which Panama hats are made, is obtained from five or six species of the palm. The most important of these is known as *Carludovica palmata* and grows in the warm, moist regions of the Pacific coast in Colombia and Ecuador, and also in the forests of Peru

along the headwaters of the Amazon. This palm attains a height of 6 ft. to 10 ft. The leaves are fan-shaped. Toquilla straw is exported to the United States and other countries, where the hats are made by machinery.

It has been suggested to the Colombian Government that the exportation of iraca and toquilla seeds should be prohibited in order to prevent other countries from cultivating those plants. It is also urged that it would be wise to levy a heavy export duty on the exports of toquilla straw, and to enter into an agreement to that effect with Ecuador and Peru.

A Colombian consular officer is authority for the statements that Japan is importing straw to promote the manufacture of Panama hats in that country; that at present there are large palm plantations in Formosa; and that the hats known to the trade as Jipijapas are now made in Japan, and are competing on equal terms with the products of Peru, Ecuador and Colombia.

According to a report recently sent to his Government by the United States Consul at Cartagena, Panama hats are made in Colombia in the following manner. When the palm is about 5 ft. high the most tender leaves are cut and the veins taken out, submerged in boiling water several times, and placed in the sun to dry and whiten. Further, to whiten the straw lime-juice is added to the boiling water. Then the straw is moistened to make it flexible and split with the finger-nail into strips of the required width. A bunch of the straw is tied in the middle and placed in the centre of a wooden mould. The fibres are placed in equidistant pairs, and weaving is begun in the upper part of the cup and continues in circular form until the hat is finished. The addition of fibres while weaving the crown is carefully avoided, and the number of fibres is increased to make the brim and edge. The beauty and durability of the hat depend largely upon the degree of exactness with which the fibres are interwoven. Once completed, the hat is washed in clean cold water, a coat of gum is applied, and the hat is finally polished with dry sulphur.

To weave a fine hat requires three to six months with four to five hours' work daily. Two inferior hats of ordinary straw can be woven in one day. First-quality hats of toquilla are sold in the foreign retail markets at prices varying from £5 to £20 each.

The declared exports of Panama hats from Cartagena to the United States have been steadily increasing. During the past five years the exports were valued as follows: 1910, £38,000; 1911, £43,500; 1912, £45,000; 1913, £52,800; 1914, £52,600.

Practically all the exports from this port go to the United States. During 1914 the only other market was the United Kingdom, which took hats to the value of £1,380.

The grades and current wholesale prices per dozen of Colombian hats (exclusive of commissions, charges and transportation expenses from the interior) are as follows: Electos, £1 17*s.* 6*d.* to £2 5*s.* 10*d.*; selectos, £2 5*s.* 10*d.* to £2 14*s.*; superiores, £2 14*s.* to £3 2*s.*; extrasfinos, £3 2*s.* to £3 10*s.*; finos, £3 10*s.* to £4 1*s.*; extras, £4 1*s.* to £4 7*s.*

EDISWAN ELECTRIC LAMPS.*

Since the amalgamation of the Edison and Swan companies in the year 1883, great progress has been made in electric lamp manufacture. The principal constituent of a lamp is the filament, because on its strength, economy in current consumption, and amount of light given off depends success or failure.

The filament is to-day made principally from pure tungsten wire-drawn, and it has been proved that this form of filament is exceedingly strong, will save 75 per cent. in current consumption against carbon filament lamps, and gives unexcelled brilliancy. Tungsten was at one time only procurable abroad, but can now be prepared from a tungsten concentrate obtainable in Cornwall, which enables the Ediswan company to be absolutely independent of imported raw material. Briefly, the tungsten in a powdered state is compressed under great hydraulic pressure into thin rectangular bars, which are kept at a very high temperature in a hydrogen flame, so that all impurities are removed. Then after electrical treatment, which makes the bars more solid, the material is ready for beating or swaging, which is carried out under great heat, and the finished article is a long thin rod of tungsten, which is gradually "drawn" down to the familiar thread-like wire seen in lamps. After the delicate process of assembling glass foot, stem, leading in wires, and supporting spiders (or arms) is completed and one piece is formed, the filament is wound on the supporting spiders. In bulb lamps the upper supports for the filaments are of strong and rigid nickel wire; the lower ones are of molybdenum which is thinner and more elastic.

The next process is to fix the filament in the form of a "cage" into the bulb, into which it is hermetically sealed. The lamp is then exhausted of air by pumps producing the highest obtainable vacuum. The Ediswan company is exceedingly well supplied with means for glass-making, having three large houses in full working order and a fourth (10-pot house) just being completed. The original small house used many years ago has also been reopened. The ingredients and mixing of the glass are not disclosed to anyone, because it has been the work of highly skilled chemists to produce the present high quality glass for Ediswan bulb-making.

After the preparation of a "batch" it is put into a crucible in the furnace, the glass by this time being known as "molten metal." In making

* From a report of a visit of the Society of Engineers to the works of Messrs. Edison & Swan, Ponder's End.

a bulb, one of the operatives dips his rod (hollow metal tube) in the molten glass and a sufficient quantity is deposited on the end. After a little blowing and motion through the air the partly-blown glass is placed in a mould manipulated usually by a youth, then blown to the shape of a lamp in the mould. It is then knocked off the tube and sent to a sorting department, where all imperfect bulbs are rejected. The Ediswan glass-houses are kept continuously running by eight-hour shifts.

After the exhaustion of the lamps the next procedure is to measure the candle-power and wattage on a photometer, after which the lamp is sent to be capped, the last stage being the etching on the glass bulb of the trade mark, candle-power, etc.

UTILISATION OF WASTE SUBSTANCES IN ITALY.

At a recent meeting of the "Associazione Chimica industriale Italiana," held at Turin, reference was made to the utilisation of certain waste substances and by-products for the manufacture of potash salts. The consumption of these salts in Italy has increased considerably of late years, and up to the present time that country has been dependent on Germany for the supply of this fertiliser.

It was pointed out that three other sources for the supply of these salts are at hand at home, viz.:—

(1) In the mother waters of the evaporating basins at the numerous saltworks (*saline*) along the sea-coast of Italy.

(2) From the *molasses*, or residue of the sugar works, where there is always an abundant supply.

(3) From the black watery liquid which remains in the "marc," or cake, that remains after the oil has been extracted from the olive berries. This liquid is said to contain 3 per cent. of crude potash salts, from which 50 to 60 per cent. of carbonate and from 15 to 20 per cent. of chloride of potassium can be extracted.

The soap-making industry might profit very considerably by the general adoption of the Garelli-Depaoli process, by which common salt can be substituted for soda in the saponification of fats. This might be rendered possible were the present fiscal restrictions removed—salt being a Government monopoly in the Continental part of the kingdom. In the island of Sicily, where such restrictions do not obtain, the process is being worked with satisfactory results. Rock salt is found in abundance in the province of Girgenti.

There should be in Italy, as is the case in France at Cannes and Grasse, a large field for the distillation of essential oils from flowers. This industry, with the exception of the essence of bergamot, a speciality of Reggio Calabria, and the essence of lemon, peppermint and lavender, can scarcely be said to exist in Italy, notwithstanding the large quantities of flowers cultivated on the Italian Riviera. Oil of lavender, which is used in the manufacture of a superior grade of varnish, as well as for perfumery, is made on a small scale in the valley of Susa and in the neighbourhood of the Col di Tonda. There is a great future for Italian chemical industry in the manufacture of dyestuffs, and particularly aniline colours, for which Italy has been, up to now, dependent upon Germany.

GENERAL NOTES.

Indian Wheat Forecast.—The final wheat forecast for 1914-15, covering all the important wheat-growing areas of India, shows the total estimated yield to be a record one, even higher than the heavy crops of 1903-4, 1910-11, and 1912-13. The total area now reported is 32,330,000 acres, being 13 per cent. above the final estimate of the previous year. The yield is estimated at 10,269,000 tons (or 47,923,000 quarters of 480 lbs.), showing a substantial increase of nearly 23 per cent. over the figures of last year. The outturn per acre works out at 714 lbs., or approximately 12 bushels, which is only a fair rate of productivity compared with the figures from 1903 outwards. In the United Provinces it is estimated that 7,303,000 acres are under the crop, an increase of 14 per cent., while a yield of 3,041,000 tons, or 7 per cent. larger than last year's, is anticipated. The corresponding figures in the Punjab for this year are 11,195,000 acres and 3,925,000 tons, being increases of 17 and 23 per cent. respectively. The latest available information regarding the wheat crops of the world shows the following estimates of area: United States, 41,246,000 acres, increase of 11 per cent.; Canada, 1,062,000 acres, increase of 9 per cent.; Italy, 12,350,000 acres, increase of nearly 5 per cent.; Argentina, 15,447,000 acres and 5,176,000 tons yield, increase of 70 per cent.; Australia, 790,000 tons, decrease of 71 per cent.; and Chile, 600,000 tons, increase of 90 per cent.

Glass Factories in the United Provinces.—The United Provinces Government has asked the Government of India to move the Secretary of State to appoint two Belgian or English glass experts with a view to the introduction of improved and up-to-date processes in the glass factories of these provinces. In making this request the United Provinces Government is acting on the recommendation of the committee they appointed at the outbreak of the war to investigate the possibilities of assisting local industries to capture a share of German and Austrian trade. The inquiries of the committee show that one of the most promising openings is to be found in the glass industry, which is carried on in several parts of the United Provinces. "This trade," says the United Provinces Government's letter to the Government of India, "though still in its infancy, offers great

possibilities, for not only are the manufacturers, who have already indulged in various costly experiments, possessed of capital and quite prepared to sink it in improvements, but they are also fully alive to the unique opportunity offered by the present crisis for invading the extensive markets in which German and Austrian firms have hitherto enjoyed the monopoly." The two experts, when appointed, are "to teach the business of glass-making and its methods fully and without reserve to the employés of any factory to which the Local Government may post them."—*The Pioneer Mail.*

The Professional Classes War Relief Council.—A permanent exhibition of pictures and decorative arts, under the auspices of the Professional Classes War Relief Council, is being held at 13, Prince's-gate, S.W. (by kind permission of Mr. J. Pierpont Morgan). The special features of the exhibition are portraits, miniatures, wedding presents, and rolls of honour. The exhibition is open free daily from 10–1 and 3 5 (Saturdays 10–1).

Papyrus for Paper-pulp.—The papyrus grows in great quantities on the Upper Nile, in some places covering an area of a kilometre or more on either side of the river. In 1908 experiments were conducted at the Wellcome Tropical Research Laboratories, Khartoum, with a view to ascertaining whether this could be converted into satisfactory pulp for paper-making. As far as could be ascertained from trials on a small scale, the results appeared promising. Further steps have now been taken, and an account of them is published at Khartoum in a short article by Dr. William Beam, research chemist at the laboratory. Experiments on a larger scale were carried out for the "Sudd Fuel (Suddite)" Company by Messrs. Tullis, Russell and Co., and by Messrs. Thomas and Green, under the auspices of Messrs. Cross and Bevan. These indicated a valuation about equal to esparto, and several very promising features were noted. The colour was approximately up to the standard of ordinary bleached supply, and the pulp could be used as an "entire furnish," *i.e.*, without the admixture of wood or other long fibre The raw material in the shape of air-dried stalks was estimated at about £3 per ton, delivered in England.

The Lighting of Rifle Ranges.—At the annual meeting of the Illuminating Engineering Society a discussion on "The Lighting of Rifle Ranges" was opened by Mr. A. P. Trotter, who ave an interesting account of his experiences in shooting on miniature rifle ranges. Many members of the society, and others associated with volunteer corps and rifle clubs, joined in the discussion. The art of aiming involves problems of vision, and is therefore materially affected by the lighting conditions. Men of advancing years, having defects in eyesight, are subject to certain difficulties in learning to shoot, and are specially sensitive to the defects in lighting. The ordinary method of lighting miniature ranges seems open to criticism from this standpoint, and Mr. Potter described a special system which he had successfully tried in connection with Mr. Brazil. The general impression was that the extreme contrast between the brightness of the target and the dark surroundings commonly met with in rifle ranges was undesirable, and that an attempt should be made to reproduce more closely the actual conditions prevailing in nature. Mr. A. Blok gave an account of a series of tests on various ranges in London. Experiments had been made to ascertain the desirable brightness of illumination for targets. It was agreed by several speakers that excessive illumination gave rise to an impression of "glare," and it even suggested that 15–20-ft. candles would be ample for ordinary purposes. The whole discussion was summarised in the June issue of the *Illuminating Engineer*. It is proposed to form a joint committee in order to study these problems more closely. In view of the large number of rifle ranges springing up over the country, this should be a most useful piece of work.

National Belgian Soldiers Comforts Fund.—An urgent appeal has just been issued on behalf of the above fund, which has for its object the employment of Belgian women refugees in ministering to the needs of their own soldiers. At present there are 130 work-circles scattered throughout Great Britain, and supplied gratis from the headquarters of the fund with materials for the work. The garments made are transmitted to the troops under the auspices of the Belgian Legation and the Admiralty. Letters received from the soldiers testify to the touching gratitude with which these sorely-needed comforts are received, while on the other hand the Belgian women are delighted to have this opportunity of helping their country, and are eager to have further supplies of materials; but, unless contributions are immediately forthcoming, it will be impossible to continue the good work. The committee, which has achieved remarkable results on a very small expenditure, has its headquarters in Cambridge, and contributions should be sent to the Honorary Secretaries of the Fund, 6, Selwyn Gardens, Cambridge.

A New Lubricant from Molasses.—The German press announces the grant of a patent to a Mr. H. Steffens for making a lubricating substance out of beet-sugar molasses. The United States Commercial Attaché at La Hague, in a report on the subject to his Government, states that it is not yet known whether the new lubricant is at all practicable, as it is still in the experimental stage. He adds that the normal production of molasses in Germany is about 450,000 tons a year, but that it would be an easy matter largely to increase this output.

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FRIDAY, JULY 16, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

"OWEN JONES" PRIZES FOR INDUSTRIAL DESIGN.

This competition was instituted in 1878 by the Council of the Royal Society of Arts, as trustees of the sum of £400, presented to them by the Committee of the Owen Jones Memorial Fund, being the balance of subscriptions to that fund, upon condition of their spending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings. Damask, Chintzes, etc., regulated by the principles laid down by Owen Jones." The prizes are awarded annually on the Report of the Examiners in the National Competition of the Board of Education.

Six prizes were offered for competition in the present year, each prize consisting of a bound copy of "The Leading Principles in Composition of Ornament of Every Period," from the "Grammar of Ornament," by Owen Jones, and the Society's Bronze Medal.

The following is a list of the successful candidates:—

Buswell, John B., School of Art, Nottingham, for a Design for a Machine-made Lace Curtain.

Howells, Frederick W., Broad Weir School of Art, Bristol, for Designs for Tile Fireplaces.

Wheeldon, William H., School of Art, Morecambe, for Designs for Printed Cottons.

Rowe, John H., School of Art, Dudley, for a Design for a Stencilled Hanging.

Brocklehurst, Harry, School of Art, Macclesfield, for Designs for Furniture Silks.

Grainger, Harold, School of Art, Macclesfield, for a Design for a Printed Linoleum.

The examiners who judged the works submitted for this competition report that "Generally the standard of merit is equal to that of last year, although there is a slight improvement in the treatment of colour.

"Whilst a considerable number of the designs show too close a resemblance to well-known historic examples, which, in some instances, have not been intelligently studied, there are some which are original in treatment and at the same time adhere to the principles laid down by Owen Jones.

"The most successful among the competing works include examples of lace, woven silks, tiles, linoleum, embroidery, and carpets."

SPECIAL WAR LECTURES.

On Wednesday afternoon, July 14th, Professor Vivian B. Lewes, F.I.C., F.C.S., delivered the second lecture of his course on "Modern Munitions of War." The subject of the lecture was "Mines, Shells, and High Explosives."

The third lecture, which will deal with "Poison Gases and Incendiary Bombs," will be delivered on Wednesday, July 21st, at 4.30 p.m.

The lectures will be printed in the *Journal* during the summer recess.

PROCEEDINGS OF THE SOCIETY.

FOTHERGILL LECTURES.

MOTOR FUELS.

By Professor Vivian B. Lewes, F.I.C., F.C.S.

Lecture II.—Delivered February 22nd, 1915.

Petrol Substitutes.

In the last lecture petrol was taken as the standard motor fuel, and the characteristics that fit it for that position were dealt with fully in order that we might have something with which to compare the various substitutes that have been proposed from time to time.

Prior to the demand created for it by the coming of the motor-car, petrol was almost a

waste product; it had to be distilled off from the crude oil before the kerosene, which in those days was the important product, could be obtained of a flash-point to satisfy legislative requirements, and the uses to which it was put were chiefly as a grease solvent for wool and dry cleaning, a little also being used in flare lamps of the Holliday type and for sponge lamps. When the demand for it as fuel in the internal-combustion motor first arose the supply was more than sufficient to meet it, and prices rose but slowly, the bulk of the petrol imported into England coming from America.

Before the price had been seriously inflated the Dutch East Indies came into competition with the American supply, and this tended to keep down the cost, but the use of petrol in America was growing faster than it was here, the quantities used became enormous, and as it was necessary to fill home requirements the amount available for export to England became smaller. The Dutch East Indies then became the chief source of supply, so that in 1912 more than half the motor fuel used in England came from there. The falling-off of the American competition and the freight difficulties already alluded to led to rapid rise in price, but in 1914 the American exports of petrol to England suddenly rose again to 40,000,000 gallons, this being due to three causes—first, the closing of the German market; secondly, the increased shipping facilities; and, lastly, the production of enormous quantities of spirit formed by cracking residues by the Burton process, this, however, being used mostly in America, and so setting free large quantities of ordinary petrol for export.

When the price of petrol threatened serious harm to the motor industry, feverish attempts were made to find substitutes at a lower price, and naturally the body which suggested itself was benzol, the first member of the aromatic hydrocarbon series, which is produced in the tar formed during the destructive distillation of hydrocarbons at a high temperature.

The history of benzol is an eventful one. Discovered by Faraday in the liquid condensed on pressure from oil gas, it had little or no use until the discovery of the aniline dyes by Perkin, who made aniline by nitrating benzol and reducing the nitrate by nascent hydrogen. This at once created a demand for benzol, which rapidly rose in price from that of an almost worthless by-product to the neighbourhood of 15s. a gallon, and led to not only the perfection of the methods of distillation for extracting it from the coal-tar, which up to then had been its only source, but also to many experiments being made to obtain it by the cracking of oil residues and the scrubbing of rich gases.

A little later the Germans introduced recovery plant in their Westphalian coke ovens, in which benzol could be recovered from the gases before they were utilised as fuel for heating the coal charges, and this at once led to such an increase in the supply that the price began to fall almost as rapidly as it had risen. After a lapse of many years English prejudice against recovery oven coke began to be overcome and recovery plant applied to English coking, further largely increasing the yield of benzol. This caused a still further reduction in price, and ten years ago benzol could have been obtained in very large quantities at 6*d*. per gallon. It was under these conditions that it appeared to be not only an ideal motor fuel but, being a native product, one not liable to being interfered with by external complications. Unfortunately, however, the supply, which had been more than ample for all the demands made upon it for artificial colour production and the other uses to which it was put, proved utterly inadequate when it came to entering into competition with petrol as a motor fuel. An immediate rise in the price occurred, and, as must always be the case, its price became only just sufficiently low to give it an advantage in competition, whilst the anticipations formed by certain enthusiastic supporters of benzol and the wild statements made as to the amount produced led to absolutely fallacious expectations as to the position it would take in the market.

The truth about benzol is that if we take the total yield per ton of coal carbonised in the manufacture of coal gas and in coke ovens fitted with recovery plant, the average yield of crude benzol per ton would not exceed 2½ gallons, and in all probability would be nearer 2¼, and before this could be made available for motor-car work it has to be purified and redistilled, not more than 72 per cent. of the original being fitted for use for this purpose. This means a reduction in the yield of motor fuel per ton of coal to 1·8 gallons.

During the year 1912 ten million gallons of crude benzol were produced in this country, of which four millions were exported for the foreign colour trade. Great activity in fitting recovery plant in place of beehive coke ovens so as to recover as much of the benzol as possible then took place, and in 1913 the yield of benzol rose to between fifteen and sixteen million gallons, about five millions of which were

exported. Last year the increase in the coke-oven recovery plant and its extensive working for the purpose of getting the benzol was unfortunately checked by a slump in pig iron, and inasmuch as the demand for metallurgical coke is dependent almost entirely upon the iron and steel production, this led to overstocking in coke and a slackening down of the coke ovens, with the result that the production of benzol will have fallen slightly, but the stoppage of exports of benzol to Germany during the last five months of the year will have probably brought the amount of benzol available for use in this country up to about the same level as in 1913.

Although so much has been done of late years in checking the wilful waste due to carbonisation of coal in beehive ovens and simply burning-off all the valuable by-products so polluting the air for miles around, not very much more than half the total coking of coal is done in recovery plant, and if the whole of the beehive coking ovens were abolished and all metallurgical coke made in recovery ovens, and all the tar made in the gasworks was distilled and the benzol recovered, the total possible output for this country would be thirty-six million gallons, or about one-third of the volume of the motor fuel imported into the country during last year.

It is not likely, however, that we shall ever see the complete abolition of the beehive coke oven with its wastefulness and its pollution of the atmosphere, as there are some classes of coal which swell so much on carbonisation that they do not lend themselves to coking in recovery plant.

At the present moment the overstocking of the metallurgical coke market is leading to several collieries which produce a rich bituminous coal seriously considering the question of adopting a lower temperature of carbonisation than is used either in gasmaking or coke-oven practice, in both of which the temperature is so high that the coke has the last trace of volatile matter driven out of it, and so is difficult to ignite, and requires a strong draught to keep up an active combustion. It has been proved that there is an enormous market for a coke which contains about 6 per cent. of volatile matter, which should be easy of ignition and in the domestic grate burn with a bright clear fire. The market for a gas of good heating value for power purposes is also daily becoming greater for electricity works and commercial purposes, and the demand for aromatic hydrocarbons is becoming insistent, owing to certain of them being required for the preparation of explosives used in the war, whilst others will be needed in large quantities if the much-talked-of attempt to capture the German coal-tar dye industry is to be made, and with carbonisation at 900° C., recovery of crude benzol from the tar, and also by scrubbing the gas with a heavy oil, it would be possible to obtain between 4 and 5 gallons of crude aromatic hydrocarbons per ton.

In speaking of the carbonisation of coal as a source of motor fuel it must be borne in mind that with carbonisation of coal at 450 C., as carried out in the processes described by Dr. Perkin in the course of Cantor Lectures which he has just concluded, aromatic hydrocarbons, benzol, etc., are extremely low, their place being taken by light oils of the paraffin series and naphthenes, so that these would not be a source of benzol, which, with the further members of the aromatic series, is produced in maximum quantities by the carbonisation of coal at about 900° C.

Benzol as sold as a motor fuel contains also toluol and xylol, these three being the first members of the aromatic series, and having the composition and boiling-points:—

	Formula	Boiling-point °C.	Specific gravity
Benzol . .	C_6H_6	80·5	·886
Toluol . .	$C_6H_5.CH_3$	110·0	·865
Xylol . .	$C_6H_4(CH_3)_2$	137–140	about ·87

The general method adopted for separating benzol to be used as a motor fuel from coal tar consists in distilling the tar and subjecting the light oils so obtained to further fractionation, the lower boiling fractions being separated. These fractions are purified by treatment with sulphuric acid, whereby some of the sulphur, certain unsaturated hydrocarbons, etc., are removed. This is followed by treatment with caustic soda, by which tar acids, such as carbolic acid, are eliminated from the spirit, and finally a thorough washing with water is given. The treated and washed spirit is rectified in stills provided with a reflux apparatus, which allows the more volatile portions of the vapours to pass forward for subsequent condensation; but the heavier vapours are condensed and returned to the still. In this way it is possible to collect any distillate of definite boiling-point and specific gravity.

The demand which has now arisen for toluol for the manufacture of trinitrotoluol, or T.N.T., at present largely employed as a bursting charge in the shells which on detonation give the volume of black smoke that

has earned for them the sobriquet of "Black Marias," will undoubtedly lead to further fractionations, and reduce still more the proportion of benzol available as motor fuel.

Pure benzol, generally spoken of as benzene, has the drawback that it crystallises at 6° C., but the other bodies present with it in the commercial 90 per cent. benzol used for motor fuel lower the temperature at which crystallisation takes place, whilst the addition of 10 per cent. of petrol will keep it liquid well below the freezing-point.

For use in an ordinary motor engine it is exchangeable with petrol—*i.e.*, no alterations of carburettor or engine are necessary—and it develops about 12 per cent. more power. Unless properly purified, the smell of the exhaust is objectionable, and if the crude benzol without any purification is used trouble is sometimes found from the formation of resinous bodies, which tend to cause sticking of the valves, etc.

The calorific value of benzol is, per pound, 17,750 B.Th.U. gross and 17,100 B.Th.U. net, which is considerably below that of petrol, but its specific gravity is 0·886, that is, there are 8·8 lbs. to the gallon instead of 7·2 with petrol, with the result that the heat value per gallon is 156,700 B.Th.U. gross and 150,000 B.Th.U. net, which explains the 12 per cent. higher power obtained in use.

We have seen that benzene is a definite compound, and although it contains some toluol and xylol, a far larger proportion fractionates over a narrow range of temperature than we find with an avowed mixture like petrol. Pure benzene distils at 80° C., and the bulk of a commercial benzol distils between 80° C. and 100° C.

Another definite compound usable as a motor fuel, and one which will become of more and more importance as the world's supply of oil becomes depleted by the enormous demands to which it is subjected, is alcohol. The world's stored fuels—coal and oil—represent Nature's method of fixing the sun's energy in days long past by the growth of vegetation and its gradual conversion over long ages into our great solid and liquid combustibles. It was only during a passing phase of the world's history—a few thousand years probably—whilst our atmosphere was being fitted for the coming of the higher forms of animal life, that such accumulations of vegetable matter were possible as gave us our coal-fields and our oil deposits. To-day oxidation and decay would render it impossible, and when a century hence the world finds itself bankrupt in the fuels that have served it for centuries, and searches for others to take their place, it will be realised that the rapid growth in sunny climes of roots and grain that can be fermented into alcohol will be the only method of obtaining a fuel that will be sufficiently rapid to render it available.

Ethyl alcohol, C_2H_6O, is obtained by alcoholic fermentation from almost any material containing cellulose—corn, rice, potatoes, sugar-cane, beet, wood refuse, and even sawdust can be made to yield it—and no country is without material from which it could be produced. It forms in many ways an excellent motor fuel; its limitations are known, and the possibility of using it is purely a question of Government sanction. The great curse of alcohol is that it is an intoxicant, and that Government finds in taxing it and hedging it round with legislative restrictions one of their most fruitful sources of revenue. When it must be used as a fuel it can be made at 6*d.* per gallon, but its manufacture and use are so hampered by grandmotherly precautions and restrictions that the denatured or methylated spirit that is allowed to be sold "duty free" costs 2*s.* 4*d.* to 2*s.* 8*d.* per gallon, and under these circumstances petrol would have to rise to about 3*s.* 6*d.* a gallon before alcohol could compete successfully with it.

The denaturation or methylation of alcohol consists in mixing with it something that cannot be again separated easily, and which will render the mixture so nauseating that the most hardened drunkard cannot drink it in theory. As the law at present stands, only what is termed "mineralised methylated spirit" may be used as a motor spirit; it consists of alcohol (96 per cent. strong) mixed with one-ninth of its volume of wood naphtha and not less than three-eighths of a per cent. by volume of petroleum, which renders it turbid if mixed with water.

The wood naphtha or wood alcohol, CH_4O, used for denaturation is obtained from the pyroligneous tar yielded by the destructive distillation of wood, and its use for denaturing alcohol for motor use is responsible for one of the chief objections urged against the use of alcohol for this purpose, and that was that it caused corrosion of valves and other working parts. This, however, has proved not to be the case when other denaturants have been used; but there is a strong probability that if an engine is running light, and the temperature is low, a partial oxidation might lead to the

formation of an aldehyde, which might be converted into acetic acid.

The fact that the molecule of alcohol contains oxygen affects its calorific value, and if we make a comparison between methylated spirit and a ·722 petrol we find that the B.Th.U.s contained by a pound of alcohol are not very much more than half those of the petrol, so that if merely the thermal values of the two fuels were taken as representing their production of power, alcohol would not have a chance of competing with petrol.

I have already pointed out that the thermal value of a fuel is by no means a safe guide to the work that it will do, and alcohol is an excellent example of this. We have seen that the efficiency of a good form of petrol motor is 22, that is to say, only 22 per cent. of the heat value of the petrol is converted into work, and the loss which takes place is dependent upon a large number of different factors, such as the compression that can be used without fear of premature ignition, the amount of air needed to produce complete combustion, the cylinder temperature, and other points of similar character.

With petrol it is unusual to exceed a compression of more than 70 lb. for fear of pre-ignition, although it is sometimes carried to 90 lb., but with alcohol compressions as high as 200 lb. can be employed. In the next place, a pound of petrol requires 15 lb. of air for its complete combustion, whereas with alcohol only 8·75 lb. are needed, which means that the volume of inert nitrogen in the air which has to be heated to the same temperature as the other cylinder gases, and which acts as a diluent in slowing down combustion, is reduced by nearly one-half in the case of alcohol. Further, we have seen that the explosive range for petrol is extremely low, so that it is difficult to get the exact explosive mixture; but with alcohol the explosive range is more than doubled, whilst the explosion being much cooler than in the case of the petrol the cylinder temperature is not so high, and all these factors being to the advantage of alcohol we find that the efficiency of the engine using it can be increased to as high as 38, and that in trials with properly constructed engines the result given by alcohol, volume for volume, is very nearly equal to that of petrol.

As regards safety alcohol has an advantage over petrol, which is of the greatest possible importance: its flash-point, instead of being below the air temperature, is 58° F., so that instead of a summer's day causing volumes of vapour to be given off, as is the case with petrol, the evaporation is comparatively low; it does not creep in the same way that petrol does, and being much lighter than petrol vapour does not flow over the ground in the same way, whilst, being miscible with water, if it catches fire it can be extinguished readily and easily.

In France considerable attention has been paid to the utilisation of alcohol in motor-cars, and so important was the use of alcohol considered in Germany that the manufacture of alcohol by fermentation from potatoes was State-aided in order to keep labour on the land as far as possible; and alcohol for motor use became a commercial success, the benefits of which are being reaped at the present time when, the petrol supplies having been cut off, a petrol famine exists.

Our interest in petrol substitutes may be summed up as a desire to get a motor fuel cheaper than petrol; but if we desire to have an object-lesson in what we could do if petrol and petroleum products failed, we have only to turn to Germany's plight at the present moment, and there the subject is found to be one of the most serious national importance.

The whole conduct of the war depends on motor traction without it the movement of troops is hampered, the commissariat cannot be carried out properly, the supply of ammunition to the fighting line fails, and the Red Cross Service is rendered inefficient. At the same time, there is practically a petrol famine, and what there still is must be kept for the fighting line and the air service. Under these conditions the experience the Germans have had in using alcohol as a motor spirit is proving of great value in meeting the emergency. Every motor-car in Germany has been adapted to burn alcohol as well as petrol by fitting suitable carburettors that could be adapted to either fuel, and when used with alcohol could be warmed up to give the power of starting. We have seen that the thermal value of alcohol is only a little more than half that of petrol, but that higher compression is possible and makes the efficiency nearly the same; but the compression cannot be altered without serious alterations to the engine which would unfit it for use with petrol, whilst if the alcohol is used in the engine as arranged for petrol the power obtained would follow the ratio of their heating values. Nearly twice as much alcohol as petrol would have to be burnt to give the same power. In order to get away from these troubles

without any more alteration than that of the carburettor, a mixture of alcohol with benzol in which naphthalene has been dissolved to give it higher heating power is used. The favourite formula is :—

95 per cent. alcohol	80 litres.
Benzol with 200 grammes naphthalene dissolved in it	20 ,,
	100

And such a mixture when used without any extra compression gives five-sixths the power of petrol, whilst all the ingredients are made in the country.

It will be interesting to see in this connection how much motor fuel can be possibly made available in Germany.

In 1913 Germany produced 160,000 tons of benzol, of which 50,000 were exported; all exportation will now have ceased, and if we suppose the production to have been maintained and one-third recovered from the crude benzol as toluene, this would leave, allowing for wastage, 100,000 tons of benzene, or a total of 25,000,000 gallons, which, with the amounts used at both fronts and in the towns, would be at most six weeks' supply if used alone.

The production of alcohol in 1913 in Germany was 3,750,000 hectolitres, or 82,500,000 gallons; so that, supposing the whole of the benzol and alcohol made in the country were blended and the naphthalene, of which there is plenty, dissolved in it, the whole production of motor fuel possible would be a little less than the amount we imported last year, and would mean about a five months' supply at the present rate of consumption.

Leaving the simple compound class of motor fuels, we come to a large class of mixtures in which heavier portions of the crude oil are used.

In the distillation of crude oil the second cut consists of kerosene distilling between 150° C. and 300° C., and the volume of this grade is, of course, enormously greater in nearly all crude oils than that of the benzene or first cut. The demand for it also is still very large, the amount imported into England last year being 146,600,000 gallons, or some 26,000,000 gallons more than the petrol spirit.

Five or six years ago oil of this character could be got at 3*d.* to 4*d.* per gallon, whilst petrol was already over 1*s.*, and many attempts were made to form mixtures of it with benzol or petrol in sufficient quantity to allow of starting, and when the temperature of the cylinder and inlet pipe had got sufficiently high, and a good spray carburettor was used, such mixtures, if made in the right proportions, worked perfectly well as long as they were used for steady running without any great fluctuation in speed. Directly, however, one got into heavy traffic troubles began to show themselves, as the range over which the mixture of kerosene spray and air is explosive is even more narrow, indeed not more than one-half of that of petrol-air mixtures.

There must have been twenty or thirty patents taken for mixtures of this character, the nature of which was attempted to be disguised by the introduction of small quantities of other substances, which generally had no effect whatever, or by fantastic methods of treating and purifying the mixture before use. Given, however, the right proportions, the mixtures are of considerable commercial value for steady running on country roads, as, for instance, postal vans from London to the country centres, or the transport of goods over long distances. Even kerosene can be used by itself in a motor engine with an atomising carburettor as long as all the working parts are sufficiently hot when the kerosene is turned on and nothing happens to alter the ratio of oil to air. Several attempts have been made to utilise this fact by fitting double tanks and carburettors to the car, so that it can be started on petrol, and when thoroughly warmed up switched on to the kerosene, when the engine would run perfectly well until on slackening the supply was throttled and the engine would stop dead, owing to the proportion of oil vapour to air being thrown outside the narrow range over which it is explosive.

I have made many experiments on such mixtures, and for anything approaching satisfactory work the petrol has to constitute practically half the mixture before good results are obtained, and when, as at present, the price of kerosene is high very little saving can be secured.

Perhaps the most successful mixture of this class is 50 per cent. of kerosene distilling up to 250° C. with 40 per cent. of ordinary petrol having a specific gravity of about ·720, and 10 per cent. of benzol, the idea of such mixtures being that in a mixture of liquids of different boiling-points the escape of the vapour of the most volatile constituents carries with it considerable proportions of the ingredient of next higher boiling-point, this again helping the volatilisation of the still heavier fractions. Also if a carburettor is used that sprays the mixture as a fine mist into the cylinder, each particle of the mist will be a drop of microscopic size containing the constituents of the mixture,

and as the more volatile portions of each particle evaporate the particle itself is reduced rapidly in size until the last portion of the heaviest oil is so finely divided that its complete combustion is easily brought about. I think, therefore, that for commercial work mixtures of this character might often be employed satisfactorily. The rate of flame propagation in the mixture, however, is a side question that must not be overlooked, as if the rate of burning is made progressive, as it would be in such a case, it is obviously not fitted for very rapidly running engines, as a slow-burning mixture might not have completed its combustion by the time the inlet valve opened, and firing back would take place. It seems probable that the admixture of oxidising agents with heavier oils renders them more easy to burn in the cylinder of the internal-combustion motor, and in France it has been quite a usual practice to mix small quantities of picric acid and other nitrated hydrocarbons with the oil.

It has also been claimed that the admixture of small quantities of hydrogen peroxide to the oils exerts a remarkable influence on the way in which they burn, and enables heavier fractions to be used successfully. With all this class of motor fuels, starting from cold and flexibility in running have been the main troubles to contend with, and excellent results have been attained by the solution of hydrocarbon gases in them, which being readily disengaged have given the necessary ease of starting, and by having a wider range of explosion have endowed the fuel with flexibility. Of all the gases fitted to use in this way acetylene is undoubtedly the best, as it is of high calorific value, and so adds to the power of the fuel; it is also fairly soluble in benzol and alcohol, and so can be made of special value in giving to mixtures of them the desired starting power from cold, whilst having the greatest known explosive range it endows the mixture with flexibility in running. The right way to use it is to make a standard solution of the gas in benzol, one volume of which holds four volumes of acetylene in solution, and in making the motor fuel to add sufficient of this to give the necessary starting power.

I have known a motor spirit containing a mixture of kerosene and petrol touched up with a benzol solution of acetylene, retain its starting power for nine months, showing that when in true solution the tendency to "stale," so common with mixture fuels, does not take place to any large extent. When alcohol comes into use as a motor fuel this property may prove of considerable value, as one volume of alcohol dissolves six volumes of acetylene.

Even hydrogen, the least soluble of all gases, has been used for treating ordinary petrol, and it is claimed to give a 20 per cent. saving in consumption. In this case the escape of the small quantity of hydrogen from the petrol carries with it petrol vapour, and as the igniting point of hydrogen is less than one-half that of petrol vapour, it probably flashes through the gaseous mixture in the cylinder and causes a more rapid and complete combustion — it acts, in fact, like a priming of small grain gunpowder in a heavy charge of prism powder.

I alluded at the commencement of this lecture to the large quantity of residual oil that was being cracked in America for the production of motor fuel, and there is no doubt that whilst the world's production of crude oil remains at its present enormous figure such processes will be able to supply sufficient spirit to enable the petrol to keep up with the demand. The cracking of oil depends on the property which heavy hydrocarbon molecules possess, of dissociating under the influence of heat into simpler groupings of their atoms, so that when a heavy hydrocarbon is heated, instead of breaking up at once to carbon and hydrogen, the decomposition takes place in step with formation of bodies of more and more simple structure, until eventually entire decomposition takes place, whilst at the same time that this is going on the action of heat on the disintegrated groups of hydrocarbons nascent in the solution brings about polymerisation amongst them, and leads to the formation of heavier as well as lighter portions of an asphaltic character. If, however, the right conditions of temperature and pressure are employed, it is possible to convert a large percentage of the heavy residual oil into fractions light enough to be used as motor spirit.

This fact was first noticed in America in 1861, and four years later James Young, the father of the Scotch shale-oil industry, found that in the fractional distillation of the shale oil the volume of light spirits obtained could be largely increased by carrying out the process under pressure, an action which Sir Edward Thorpe and John Young in 1871 explained by means of an exhaustive research in the laboratories of Anderson's University, Glasgow, which was communicated to the Royal Society, and forms the most valuable contribution that we have to a knowledge of the actions taking place.

We have seen that the saturated hydrocarbons form a complete series, of which methane or

marsh gas is the first member, each succeeding member of the group being formed by the addition of one group of CH_2, so that in each member of the series the ratio of carbon to hydrogen may be expressed by the formula C_nH_{2n+2}

The four simplest members of the group are gaseous, and with the fifth commence the liquids, which extend from C_5H_{12} to $C_{14}H_{30}$; the hydrocarbons then become semi-solid, vaseline being a mixture of $C_{15}H_{32}$ and $C_{16}H_{34}$, and still higher we have true solids, such as paraffin wax, the highest member of the group isolated being $C_{35}H_{72}$. In order to work upon as nearly a definite compound as possible, Thorpe and Young took paraffin wax for their experiment, and distilled it in an iron mercury bottle connected with a second by a bent tube carrying a pressure gauge and stopcock. The distillation was carried out over an open coal fire, one bottle containing the paraffin being heated, whilst the other acted as a condenser. In about four or five hours the distillation was completed, the pressure throughout being kept at 25 lb., and a magma of oil and unaltered paraffin resulted, which could be liquefied completely by the warmth of the hand. Four litres of liquid hydrocarbons were obtained from $3\frac{1}{2}$ kilos of paraffin wax, and on a preliminary fractionation gave -

Below 100° C.	0·3 litre
„ 100-200 C.	1·0 „
„ 200-300 C.	2·7 „

Repeated distillations of the portion boiling below 100° C. resolved it almost entirely into three fractions :—

(1) 32-38° C., consisting of pentane and amylene.

(2) 65-70° C., consisting of hexane and hexylene.

(3) 94-97 C., consisting of heptane and heptylene.

Members of the acetylene and benzene series were absent.

Extended experiments with portions distilling from 100° C. up to 300° C. and the solid hydrocarbon left above 300° C. showed them to be mixtures of saturated hydrocarbons and olefines.

In the fractions distilling below 100° C. these two classes of bodies were in nearly equal proportions, but above that temperature the proportion of paraffin hydrocarbon to olefine became gradually larger as the molecular weight increased, and from this it appears that the primary action in "cracking" is a resolution of the heavier paraffin hydrocarbons into simpler members of the paraffin and olefine series.

ABOLITION OF LEVEL CROSSINGS ON AMERICAN RAILWAYS.

The following particulars respecting the abolition of level crossings on railways in America were given recently in an interesting article entitled "Eliminating Grade Crossings" published by the *New York Times*. From this we learn that much has been done in the States during the last few years for safeguarding the public at dangerous crossings by causing the roads to pass either below or above the railway lines.

Although the English standard of safety cannot yet be said to have been reached, it should be remembered that the conditions which obtained in the two countries when railways were first made were completely different. In England, for instance, the first lines were built through a well-populated country, in the face of considerable opposition from public and private landowners. In consequence a high standard of safety was insisted on at places where the lines crossed private roads and public highways.

In America, on the contrary, the construction of the railroads went ahead of the settlers free from such restrictions, the main object being to open up the country by getting the lines made as quickly as possible. Every road crossing was at the level of the rails. In many of the Western cities the lines were laid through the main streets. Now that the country has grown up to the railways, and the highway traffic become more dense, each unprotected crossing becomes a danger to the public.

In the State of New York alone it is estimated that out of upwards of 10,000 railway crossings no fewer than 6,800, or about one for every $1\frac{1}{4}$ mile of railway, are entirely unprotected, except for a simple notice board. In the other States of the Union conditions are probably less satisfactory.

A report issued by the National Highway Protection Society for 1914 states that 199 persons were killed at level crossings that year in the State of New York alone, as compared with 124 and 107 respectively during the two preceding years. Of these 66 per cent. were pedestrians.

No fatal accidents to tramcar passengers appear to have occurred during the last two years at railway crossings. This is evidently due to the existing law in this State, which requires all tramcars to stop and the driver to be assured that the way is clear before proceeding on his journey. Had such regulations been in force also for motor-cars, the lives of 64 persons who were killed last year might probably have been saved.

The abolition of level crossings in the State of New York, and especially on Long Island, has made considerable headway during the last ten

years. There are on Long Island about 960 crossings, protected and unprotected, to about 400 miles of railroad. That is to say, on Long Island there are about 9 per cent. of the entire number of crossings in the whole State of New York, while the area of the island is but 2 per cent. that of the State, and the railway mileage about 4½ per cent. When to this is added that 20 per cent. of the population of the State live on Long Island, it will be readily seen that the problem is more acute there than in any other section of the country. It was especially for the relief of this territory that a comprehensive scheme was elaborated for the elimination of practically every level crossing within the limits of towns.

A beginning was made some years ago, and work is still in progress, whereby the lines are in some places raised and in others lowered, in order to suit the particular requirements of each locality.

The Long Island railroad is but an example of what the railways are doing throughout the country, according to their ability and as conditions warrant. The New York Central has within a few years elevated its lines through the City of Yonkers, and is conducting considerable elimination work throughout its network, and many other railway corporations are following its example at a cost of many millions of dollars.

In New York State and in several others the abolition of level crossings has been hastened and encouraged by the wise policy of the State and local authorities in contributing to the expenses of such work.

To get rid of approximately 9,000 level crossings in New York State, at a moderate average of 20 thousand dollars (£4,000) each, will necessitate a total expenditure of 180 million dollars (£36 millions sterling). This is a large sum to be spent for an object not directly remunerative to the owners of the railways; but by the method of co-operation, which has been so successful in New York State, it is hoped that in ten years' time only a few level crossings will be in existence, and these only on the unfrequented branches of the main arteries of commerce

PRECIOUS OPAL DISCOVERY IN SOUTH AUSTRALIA.

Although the present conditions in the less-known portions of South Australia are by no means favourable to systematic prospecting, several additions have of late been made to the known mineral wealth of the State. Recently the Government Geologist inspected, in Adelaide, a number of precious opal specimens which are reported to have been obtained in the neighbourhood of Stuart Range, to the westward of Anna Creek Station, by a party of prospectors who were in search of gold. Reporting to the Minister of Mines on these, the Government Geologist states: "The specimens were evidently secured from veins in the desert sandstone formation, and are quite the best obtained in South Australia. The general characteristics of the samples are in all respects similar to those exhibited by material obtained at White Cliffs, in New South Wales, where also the desert sandstone is the formation containing the opal. This new discovery in South Australia is a highly encouraging one, inasmuch as it has been made within the limits of a formation which occupies an immense area in the north-eastern quadrant of the State. This desert sandstone formation, which is of upper cretaceous age, has not hitherto contributed to the mineral production of South Australia, and the new discovery therefore adds another geological horizon to the list of those which are worthy of the attention of prospectors. Precious opal is always associated with opal possessing no commercial value. But the samples which I have just inspected contain a proportion of the precious variety that is more than sufficient to justify careful and systematic prospecting. It is reported that the deposits extend over a very large tract of country, some thirty square miles having been taken up under search licence.

DETERMINING TOTAL SULPHUR IN RUBBER.

In order to learn whether or not the methods recently published for the determination of sulphur in rubber were any improvement over the Waters and Tuttle method, now in use at the Bureau of Standards, United States Department of Commerce, that Bureau has made a study of the methods, and has recently published the results of the study in a technological paper.

The methods investigated were those of Spence and Young, Deussen, Alexander, the Joint Rubber Insulation Committee, Kaye and Sharp, Frank and Marckwald, and Waters and Tuttle. These were subdivided, according to the method of attack, into three classes direct solution, direct fusion, and solution and fusion methods. A large number of determinations were made on a number of samples, two of the latter being of known composition which were specially prepared at the Bureau of Standards.

The methods which have been compared may be divided into two classes, viz., those for the determination of the total sulphur and those for the determination of sulphur other than that present in the insoluble sulphates. It was found that the methods of the second class could not be relied upon to give accurate results.

The direct solution methods, those of Spence and Young and Deussen, involve the use of concentrated nitric acid. This was first suggested by Henriques, but is objectionable because it gives rise to low results.

In direct fusion methods, those of Alexander, the Joint Rubber Insulation Committee, and Kaye and Sharp, are reliable only when the free sulphur content is low, and are therefore not applicable to routine analysis.

The solution and fusion method of Frank and Marckwald was found to be unreliable when the free sulphur was high. The Waters and Tuttle method was found to give satisfactory results and recommended for general use.

A new suggestion is offered, namely, to determine separately the free sulphur and the sulphur remaining after the extraction, reporting the sum of the two quantities as the total sulphur. This procedure eliminates the troublesome effect of the free sulphur upon the determination of the total sulphur.

RESOURCES OF THE CHENGTU DISTRICT.

The Chengtu district of the Province of Szechwan (China) comprises an area of approximately one hundred square miles, and includes such cities and market towns as Kien Yang, Lochi, Chiaokiatu, Kwaichow, Sison, Shi Chiao, Lungchuanyi, and others of less importance. The population of the city of Chengtu, the capital of Szechwan Province, is about 500,000, while the population of the Chengtu district above described is 2,000,000.

The Chengtu district imports a larger quantity and a better class of foreign goods than any other part of Szechwan Province. There are many large shops at Chengtu that handle foreign groceries of all kinds, clothing, shoes, hats, toys, medicines, toilet articles, hardware, and various other household supplies. Foreign wines, cigars, and cigarettes are sold in considerable quantities. Small sewing machines, as well as large ones for manufacturing purposes, are readily disposed of, and cotton gins and several lighting plants have also been sold there recently.

The chief exports of the Chengtu district are hides, silk, herbs for medicine, sugar, salt, bamboo, cotton, and rice. New industries also are starting and are making considerable headway. Cotton cloth is being manufactured to a greater extent, as well as ready-made clothing, hats, shoes, and leather goods of a general character. Many of these exports are sent direct to Japan, but most of them are sold to merchants in Chungking or Shanghai, who export a certain amount.

Shi Chiao is noted for sugar, while cotton and rice are shipped largely from Lochi. Rice is grown throughout much of the Chengtu district; the same may be said of sweet potatoes, peanuts, and maize. Oranges, peaches, persimmons, pears, and other fruits are largely grown—oranges chiefly in the vicinity of Chiaokiatu. As the Chengtu plain is watered by an extensive irrigation system, it can always be depended upon to supply regular and abundant crops. Wheat, rape, beans, peas, and millet are also grown as staple crops, especially on the plain, oats and buckwheat being likewise cultivated to a certain extent. Enormous quantities of vegetables are produced, chief among which are the turnip, carrot, cabbage, onion, and lettuce. Pepper, ginger, and mustard are largely used as relishes. Tobacco is extensively grown in this district, and is now being employed by a foreign company in the manufacture of cigarettes for local consumption.

While there are several small waterways traversing the region, they are navigable for large boats only during a certain part of the year. Rail transportation is much needed, and electric lines would probably be best at the present time. American engineers who have recently visited this district state that electric railways could not only be constructed with comparative ease, but would prove highly profitable from the very beginning. Cheap water-power could be obtained from the rivers, and the level character of the country would make construction extremely simple. A system of railways would stimulate industry and business to a wonderful degree, and would greatly reduce the cost of transportation.

As the district about Chengtu develops there will be an increasing demand for foreign machinery, says the United States Consul at Chungking in a recent report. Mining machinery is needed in the development of the region west of Kwanhsien, where lead, coal, silver, and copper deposits are said to be extensive. There is also a demand for machinery for the scientific refining of salt and sugar, and for the manufacture of paper, shoes, soap, candles, and many other articles. Modern sawmill machinery will eventually be introduced. Machinery for silk and cotton weaving could be used to advantage; much of the Tibetan wool that comes from Tachienlu to Chengtu could be made into fabrics at the latter city, where labour is cheap and water-power available.

A tannery with modern methods has already been established at Chengtu, but a larger plant is needed, and a considerable amount of foreign machinery will, no doubt, be added to the present equipment.

ITALIAN PIUMA-GRASS BROOMS.

Piuma grass is a tough grass used in Italy in the manufacture of brooms for sweeping highly-polished floors, for which purpose they are very satisfactory. It is a product of swampy regions, particularly in South-eastern Lombardy, Southern Venetia, and Northern Emilia, in which places it is said to grow abundantly. Mantua in Lombardy, according to the American Consul at Milan, is the centre of the trade in piuma grass. Peasants around Mantua gather it during the first three weeks in September, about two weeks before it begins to blossom. Soon after it is gathered it is spread on dry ground, and turned over frequently with wooden pitchforks until almost all the moisture has disappeared. It is then put up in packages of 22 lb. each, which in

turn are bound together so as to form bales of 220 lb. each.

Brooms of this grass are manufactured in Mantua and Cremona, and there are also a few factories in Milan. They are made in four sizes for the trade in Milan. The largest size is used for sweeping highly-polished floors, and is formed of three small bunches of the grass, each tightly bound at the stems, generally by means of a vegetable binder, such as raffia. These bunches are placed side by side in a fanlike arrangement, and are tightly secured in that position by a wire near the handle, and by strong vegetable fibre just above the stems. The brush thus formed is compact but soft, and does not scratch the floors upon which it is used.

The three smallest sizes of the brooms are made up of one single round bunch of grass, tightly bound with raffia to a handle. In making the largest brooms about a pound and a quarter of dry grass is used, and for the other sizes about three-fourths, one-half, and one-third of a pound respectively are required. Both the raw grass and the manufactured brooms must be kept in dark and very dry storehouses, as they are liable to blossom if left in a damp place. This is one of the great drawbacks of the article.

IRON-ORE SURVEYS IN THE PHILIPPINES.

The party sent out by the United States Bureau of Science, consisting of the Chief of the Division of Mines, one mining engineer, and one assistant, which has been engaged during the early part of this year upon a survey of the recently discovered iron ores in Surigao Province, has returned to Manila, and as soon as analyses of the samples taken can be completed a statement will be published as to the quality and extent of the Surigao iron ores.

The examination just completed involved the drilling of a total of about 650 metres (1 metre = 3·28 feet) of test-holes, distributed over an area of about 100 square kilometres (1 square kilometre = 0·3861 square mile). In this manner some 250 samples of the iron ore were obtained, from the analyses of which it will be possible to judge whether the ore is generally of good quality and whether the deposit is uniform in character.

According to a despatch received by the United States Department of Commerce from a correspondent at Manila, the findings of the engineer who first reported the existence of this deposit were confirmed in that the deposit was found to be singularly like the famous Mayari iron ores near Nipe Bay, Cuba, in its occurrence—that is, it is a great surface blanket of iron-bearing clay, which has resulted from the weathering and decomposition of the original rock. In the case of the Surigao deposit the parent rock is made up principally of the mineral serpentine.

The territory covered by the iron ore is almost barren when compared with the tropical country surrounding it, and consists of low mountains or hills, with precipitous slopes draining into canyon-like valleys. Although the hills reach an extreme elevation of only 300 to 400 metres, and most of them are less than 200 metres high, yet the vegetation is of the stunted and brushlike varieties common to extreme altitudes in the Philippines.

Huckleberries, for instance, which are found most commonly in the highlands of northern Luzon, grow profusely over the iron-ore deposit at elevations as low as 150 metres. According to the geologists of the Bureau of Science, this condition is probably due to the character of the soil and the abundance of rainfall of the ore deposit.

While the limits of the iron-ore deposits include more than 100 square kilometres and the ore is at places 30 metres thick, a considerable portion of the area is so eroded that the barren underlying parent rock is exposed. Over a still larger portion the iron-ore blanket is too thin to be of value. This condition, which will make necessary a reduction of the estimates of tonnage that were given out with the announcement of the discovery, is due to the precipitous character of the region, and to the excessive rainfall which prevails there. Had this portion of Surigao Province maintained itself as a plain or a level plateau, the iron-ore blanket covering it would have been less readily carried away by erosion and there would be present to-day a much greater tonnage of ore.

There are natural harbour facilities near parts of the deposit where safe ports could be established, and two river systems which afford water power possibilities.

INDIAN AGRICULTURE.

A volume summarising the multitudinous agricultural returns collected by local governments of India, and including the results of the periodical cattle censuses and crop reports for the whole of British India, has been issued by the Director of Statistics. It contains charts, diagrams, and a *resume* showing the strength and progress of Indian agriculture during the present Viceroyalty The number of cattle (bulls, bullocks, cows, buffaloes, and young stock) in India amounts to the enormous total of 130 millions, an increase as compared with the number a decade ago. The United Provinces account for 22 per cent. of the total numbers; Bengal, 19 per cent; Madras, 14 per cent.; Bihar and Orissa, 12 per cent.: the Central Provinces and Berar, 9 per cent.; the Bombay Presidency, including Sind, only 7 per cent. In the case of ploughs also the United Provinces come first, with 28 per cent. of the total (excluding Bengal, for which figures are not available), followed by Madras with 22 per cent.; Bihar and Orissa, 17 per cent.: and the Punjab, 11 per cent. respectively.

The total revenue from land, excluding cesses for British India, amounted in 1913 to over Rs. 32½ crores. The revenue per head was 7 annas in Bihar

and Orissa, 10 annas in Bengal, as against 33 annas in Bombay and 77 annas in Lower Burma. The area under crops in 1913 was 255 million acres, or an increase as against the previous year of 2½ per cent. of this total cropped area.

Food crops occupy 83 per cent., and non-food crops the surprisingly low figure of 17 per cent. Of the percentage under food crops (83) 80 per cent. is food grains; fruits and vegetables 2 per cent., and sugar only over 1 per cent. Of non-food crops (17 per cent.), 7 per cent. is under fibres, *e.g.*, cotton and jute, and 6 per cent. under oil-seed. Of the gross area of British India nearly 617 million acres (36 per cent.) is the net area cropped, 8 per cent fallows, 19 per cent. culturable waste other than fallows. The area not available for cultivation is only 24 per cent., and forests are 13 per cent. The proportion of cropped to total area is highest in the United Provinces (53 per cent.) and lowest in Sind and Burma (13 per cent each). The percentage for Bengal, Bombay, and Bihar and Orissa is 51 per cent.; for the Punjab, 40 per cent.; and for Madras, 38 per cent.

The total area irrigated is the large figure of 15½ million acres, and while the proportion of irrigated to total cropped area is as high as 82 per cent. in Sind, 47 per cent. in the Punjab, the percentage in Bombay, Central Provinces, and Berar is as low as 4 per cent.

RUSSIAN EXPLORATION IN THE ARCTIC SEA NORTH OF SIBERIA.

The two Russian ice-breakers, the "Vaigatch" and "Taimyr," to which vessels was due the discovery in 1913 of the previously unknown islands to the north of the Cape Chelyuskin, the northernmost promontory of Asia, succeeded in the course of last summer in carrying out a fresh voyage of discovery under the command of Captain Vilkitsky. Starting from Vladivostok the vessels made for the north-eastern passage, which had not been traversed since Professor Nordenskiold's notable journey in 1878 79 on board the "Vega." The telegrams handed in at the wireless station erected at the Yugor Shahr gave a clear description of Vilkitsky's cruise. During the course of their trip the "Vaigatch" and the "Taimyr" discovered a new island S E. of Bennett Island in 76° 10′ lat. N. and 153° long. E. The two islands proved to be much the same size and appearance, and it is curious that the crew of the "Jeannette," during their unfortunate expedition, failed to perceive the island which has just come to light, as they must have passed within thirty miles thereof in clear weather. After that the Russian expedition proceeded westward and explored the new land named after the Emperor, Nicholas II. land, situated north of Cape Chelyuskin and lying off the southern part of the coast, and discovered four small islands. On August 23rd the northernmost point of Asia was passed, and on the further side a dozen or so islets were discovered, some of which had been already visited and examined by Nansen. Further west vast fields of ice were encountered, and the two Russian vessels found themselves imprisoned in the pack west of the Taimyr peninsula. At the time of writing the expedition was not in any danger, being sheltered from the pressure of the ice; unfortunately they were running rather short of fuel, and had only about three weeks' supply left. Captain Vilkitsky had accordingly wired for 400 tons of coal to be forwarded to Port Dickson, at the estuary of the Yenisei, and if this supply could not be arranged for, communications would be opened up with the "Eclipse," commanded by Captain Sverdrup, and wintering in that part of the Polar regions.

At the beginning of the year 1914 the Russian Government bought two Norwegian whalers, the "Hertha" and "Eclipse," for the purpose of instituting a search for the three expeditions of Sedof, Broussilof and Roussanof, which had set out for the northern island of Novaya-Zemlya in 1912, and whose fate was causing some anxiety The two whalers, commanded by Captains Johannof and Sverdrup, set out for the Arctic from Christiania on July 13th, 1914. Both were provided with apparatus for wireless telegraphy. From a wireless message received in Petrograd it appears that the "Eclipse" wintered on the north-west coast of the Taimyr peninsula, not very far from the spot where the "Baron von Toll" wintered in 1900 01. No mention was made by Sverdrup in his brief message of the Broussilof and Roussanof expeditions, from which it was inferred that no signs or traces of the vessels were apparent, and that these two explorers had perished like the first.

CACAO IN THE DOMINICAN REPUBLIC.

Cacao-growing has proved to be a most profitable form of agriculture in the Dominican Republic, and its cultivation has steadily increased during recent years. It is now the second crop in importance in the Republic, and in 1913, when low prices for sugar prevailed, it held the first place in the value of exports. New acreage is constantly being planted, and there is every reason to think that the increase shown in past years will continue.

According to a recent report by the United States Consul at Puerta Plata, most of the cacao grown in the Republic is produced in the Puerta Plata district, and it is expected that the 1915 crop in this district will be at least as large as that of 1914, which was approximately 37,121,000 lbs., valued at £684,580. At the commencement of the year everything pointed towards a record crop, but a prolonged dry spell coming at a critical time checked the development of the young pods, causing them to dry up. It is estimated that a loss of 20 to 25 per cent. has been sustained in this way.

The prices during the current year have been very satisfactory. Dominican cacao, which is

known to the trade as Sanchez, has fetched as much as 74*s.* per 100 lb. in New York this year, although at present the price is somewhat lower. Growers have received from 5*d.* to 7*d.* per lb. for their crop.

The principal harvest occurs in the months of April, May, and June. There is also a lesser harvest from November to February. The crop season varies somewhat with the location of the plantations. The greater part of the exports go to New York, and it is estimated that the exporter incurs expenses of 6*s.* 3*d.* per 100 lbs. in delivering the product in that city. The prospect of a good average crop commanding a high price is one of the most encouraging features of the general commercial situation in the northern half of the country.

THE MAHUA OR ILLUPEI TREE OF INDIA.

The mahua, malwa, mowha, mowa, or mowra tree of India is a large deciduous tree throughout the forests of Dekkan, Carnatic, West Coast and Central India, and Guzerat, stretching north as far as Oudh and Kumaun, and eastward across to Orissa, according to the American Consul-General at Calcutta. Though found in a purely wild state in many parts of India, the value of the flowers and fruit has caused it to be brought under more or less cultivation. The economic value of the tree lies in its edible flowers and oil-yielding seeds, although the gum or gutta that flows from incisions or abrasions on the stems shows an average of 48·9 per cent. gutta, 38·8 per cent. resin, and 12·3 per cent. ash. The bark also is used as a dye, while many of the properties of the tree are used to some extent medicinally. The mahua puts forth its leaves from February to April. Cream-coloured flowers appear in great clusters of thirty to fifty near the ends of the branches from March to April. About the end of March the flowers begin to arrive at maturity, and every morning about sunrise the succulent corolla tubes fall in great showers to the ground, which has been cleared of grass and underbrush and prepared for the harvest. This continues to the end of April, but usually the fall from a single tree is complete in seven to ten days. The flowers are then spread out and left to dry in the sun; in a few days they shrink in size, change in colour to a reddish brown, and their peculiar sweet odour becomes more apparent. These flowers are eaten extensively while fresh, but generally speaking they are dried thoroughly and cooked with rice and other grains. Sometimes they are completely dried and reduced to a powder, and in this condition are cooked in round cakes and mixed with a variety of food stuffs. Mahua is extremely sweet, and the ability to eat and digest it must be acquired. Few Europeans are able to eat more than one flower on a single occasion without having disagreeable after-effects. Sugar and molasses of a good quality are also made of mahua.

The art of distilling these flowers is a very ancient one. For the manufacture of spirits the flowers, when dried, are sold to village distillers or Government distilleries. The flowers are immersed in water for about four days; they are then fermented and thereafter distilled. The spirit produced has at first a strong, smoky flavour, but age remedies this. The seeds of the mahua, which succeed the flower from which the spirit is made, are extensively used for the manufacture of mahua butter, which is employed in the adulteration of ghee, for lubricating and illuminating purposes, and for eating by the native people. The method of expression is crude. The kernels are taken from the smooth, chestnut-coloured pericarp by being bruised, rubbed, and subjected to a moderate pressure. In the Central Provinces the kernels are pounded, boiled, wrapped in several folds of cloth, and the oil thereafter expressed.

THE DEVELOPMENT OF THE TEXTILE INDUSTRIES.

War Conditions.—Some twelve months of familiarity with warfare have bred nothing recognisably like contempt of its varied possibilities. Perhaps even more than was the case ten or eleven months ago, the war remains the universal explanation of the things that happen within the industry and the ready apology for all that does not happen. It encompasses all things about as effectually as ever it did, but a progress not easily measurable in exact terms is perceptible. The wonderment and the particular anxieties of the early days have departed. Problems which seemed only doubtfully soluble have been solved. A basis upon which both warfare and business proceed has been found, and, when seen in a perspective which assigns small things to their proper proportions, the industrial year may appear almost incredibly marvellous. At any rate, given a due appreciation of the complexity of the general industrial, commercial and financial arrangements, and of the weight of the blow that was delivered to them, astonishment must be felt that within so brief a time from August last textile industry should find its functions so near the normal. Allowing every credit to the extraneous assistance which supported the money market through its troubles, it is justifiable to infer that the crisis caught textile affairs in general in a strong and healthy state. Assuredly the recovery would not have been facilitated by the existence of an artificial or unduly extended position of private commitments. It cannot be professed that everyone has now all that he wants, but most people have more business upon hand than they would have dared to expect either from an *exposé* of the conditions beforehand or during the conditions of bewilderment obtaining in the early days of the war.

Wool Movements.—The most strikingly lucrative effects of warfare have been seen in connection with wool, and only partly because of the pressing

demand for army clothing. It is due to consumption for that purpose that British farmers are receiving about 50 per cent. more for their wool this year than they received last; but, for the present, values for their sorts of wool may have reached the zenith. There is a very perceptible slackening of demand for clothing for the British and Allied armies, and it is conceivable that no important further purchases upon their account will be made this year. Present interest centres rather in the fine merino wools ineligible for army clothing, such as have been used mainly upon the Continent. The production of these wools has remained practically constant, the consumption demand has doubtless lessened as a whole; but whereas users had formerly to look to the Continent for the main part of the manufactures they have now to turn to England, where there are not machines enough to satisfy the demand. The result is that, while merino wools in the raw state have advanced by a trifle of $7\frac{1}{2}$ per cent. or less between May and July, the same material in its first intermediate state has appreciated about 35 per cent. The price is 45*d.* for combed wool tops which fetched 27*d.* last December, and no abatements that can be made from this comparison of prices kill the suggestion of money for somebody, although the possibility of eventual losses from so extreme a fluctuation cannot be ignored. The experience of the wool manufacturing trade is unique, but neither its gains nor those of the jute and heavy linen trades can offset the misfortunes of the greater cotton and the much smaller silk trades. There have occurred cases in which men about equally deeply concerned in two branches of the industry have lost in unrealised profits as much with one hand as they have gained with the other. The effect is to stimulate their apprehension of what may follow from a decision to tax war profits at some exceptional rate.

Dearer Money.—Manufacturing concerns have not all large unemployed resources for investment, but it is known that many have taken their opportunity to invest in War Loan, as have textile operatives, through their unions and otherwise. The rate of interest is the same, or more than, manufacturing companies return upon their debenture capital, and is equal to that which cotton-spinning companies have been accustomed to give local depositors of money upon loan. The latter, of course, have had forthwith to raise their interest, usually to 5 per cent. People seeking accommodation from their bankers have had to pay 6 per cent. and upwards, and if this increase is to be as permanent as may be thought likely it marks a highly important change in the conditions under which business can be done. The hope must be that the heavier cost of finance is not to be singular to this country alone. So much of the export trade in textile goods and the import trade in raw materials has been done by virtue of the more favourable terms prevailing in this than in some other countries that a standing addition to the cost of money becomes an anxious matter.

German Patterns.—Conditions do not favour schemes for capturing German trade by making radical departures in methods of manufacture. The machine makers are busied in military engineering, labour is short, building is forbiddingly dear, so that the replacement of German goods has to proceed by way of substitution. In consequence, displays of patterns of German-made fabrics are robbed of direct value, and made into affairs of chiefly academic interest. The analysis of a variety of saleable German cloths used by ladies' tailors has been conducted at the Bradford Technical College, and the results put on view by the Textile Institute have attracted a certain amount of attention. The exhibits inevitably reflect the characteristics of the spinning machinery that has found most favour in Germany, and the analysis reveals the combinations that have been used to produce marketable enough fabrics. The patterns cater successfully for one branch of demand, and English patterns for another. Something to admire has been discovered in the German adaptation of the means to the end, just as Germans and others have found plenty to admire and to envy in British successes in making the most of the alternative materials and machinery employed. Like cannot profitably be compared with unlike; but at all events it does not appear that any higher order of ability or ingenuity has been at work than may be seen in English-made wool goods of several kinds. The Germans have been at least as far from success in duplicating English worsted goods as have English manufacturers from making such costume cloths as have been shown, and there is more reason to think that German makers have tried harder to imitate our methods than ever British manufacturers attempted to emulate methods which have been continually regarded as foreign to their aim. What German designers of costume cloths will do when it is no longer allowed to them to go to Scotland for their inspiration is unimaginable.

Cotton Explosives.—The idea that cotton rags cannot be used in substitution for "linters" and raw cotton in making smokeless powder receives some damage from the news that the German war raw material department has requisitioned the stock of rags throughout the country. As raw cotton in Germany has advanced to fully twice the price of the coarsest cotton yarns, it is by no means inconceivable that imported yarn should have been employed for nitration, and the order forbidding the manufacture of piece goods from yarns coarser than 16's English is not inconsistent with that probability. Soft cotton waste deprived of its grease is used in explosive manufactures upon a considerable scale, and there is nothing surprising in the fact that German stocks of that

article have also been commandeered. There are guns in action that are said to shatter the equivalent of three-fifths of a bale of cotton at every round. An American estimate, which cannot be guaranteed free of defects, assesses the current consumption of cotton in the manufacture of propulsive explosives at three million bales a year, or, say, 1,500,000,000 lbs. Of the quantity so used waste cotton must form a considerable proportion. Some 13 per cent. of by-product is made in carding cotton, and the waste is, of course, cheaper than the raw material from which it is extracted. Allowing even handsomely for errors, the contrast between the estimated normal consumption for explosives with that assumed to be going on at present is an imposing one — 123,000 bales as against the reputed three millions.

Domestic Rags.—The great public is more conscious of the advance in the cost of new clothes than of the much higher prices that ought to be procurable for any discarded woollen clothing. As these relics are given away, or bartered more commonly than they are sold, owners of them are not in the best position to seize such opportunities of real household economy as the state of the rag market should afford. Taking one grade of rags with another, the price can safely be said to have doubled since the opening of the war. It may be mere trifling with hope to mention the £100 or so that might be fetched by one ton of selected stockings; but not much less than £40 a ton can be got in the best market for a fairly homogeneous lot of domestic woollens. The dustman's occupation must have been singularly golden, although the more valuable rags hardly come his way. Doubtless the itinerants who exchange crockery and trumpery for cast-off clothing have had their share of a prosperity that has surged over the marine-store dealing, rag merchanting, and rag manufacturing trades. There is quite enough to suggest that capable management would make family rag bags and old clothes cupboards as remunerative at least as some kitchen by-products to which especial attention has been directed. High prices are perhaps more effective than a sense of public duty in provoking the dispersal of private effects, but sellers of accumulated rags may enjoy both. The liberation of the supply does something to cheapen new clothing, and in no case should the act involve a sacrifice.

OBITUARY.

Evan Arthur Leigh.—Amongst the passengers of the "Lusitania" upon her last ill-fated voyage was Mr. Evan Arthur Leigh, of Yewbarrow Hall, Grange-over-Sands. Owing to his splendid health and capabilities as a swimmer, it was for many days hoped that he had survived the disaster.

Mr. Leigh in his younger days was a keen cricket player, and considered the best amateur middleweight boxer of his time. He was fond of shooting and a great believer in all sports and athletics.

His father, the late Evan Leigh, C.E., of Manchester, will be remembered as the inventor of twin-screws and detached paddles for steamships. He also designed a complete and carefully worked out scheme for conveying railway trains across the Straits of Dover and other narrow seaways, etc. In addition to being the inventor of "coupled mules with putting-up motion," "self-stripping cards," "loose boss-top roller," etc., he was the author of "The Science of Modern Cotton-spinning."

It is a matter of some interest to note that, in his early days, Mr. Leigh was intimately associated with General Ricciotti Garibaldi (now so prominent a figure in the European conflict), who was partially indebted to Mr. Leigh's father—the late Evan Leigh—for his education, and from whom he also received his first sword.

Mr. Evan A. Leigh was born in Lancashire, and inherited his father's technical abilities, being himself the inventor of many improvements in the details of textile machinery in particular, and noted for his practical knowledge of the textile trades. His business houses are Evan A. Leigh & Co., Import and Export Merchants and Engineers, Manchester, and also Leigh and Butler, Boston, Mass., where he was recognised as a model employer.

He was among the originators of the Victorian Club of Boston, a member of the Boston Athletic Association, the County Club, the Exchange Club, Boston, the National Association of Cotton Manufacturers, and of the American Cotton Manufacturers' Association He was well known in Manchester business circles, and a member of the Manchester Constitutional Club. He belonged to the National Service League, being an ardent believer in the principles laid down by Lord Roberts, and was interested in the Navy League. He was elected a member of the Royal Society of Arts in 1908.

GENERAL NOTES.

Victoria and Albert Museum.—Two important loans have recently been placed on exhibition in the Ceramic Department of the Victoria and Albert Museum. The first of these is a large collection of European porcelain, chiefly English, lent by Mr. Herbert Allen and exhibited in Room 135. This collection includes, in addition to about 170 pieces of miscellaneous Continental pottery and porcelain, upwards of 900 specimens of English porcelain. Every English factory of the eighteenth century of which the productions can be identified is represented, as well as all those of any importance of the earlier part of the nineteenth century. A few outstanding pieces may be instanced as an indication of the character of this

splendid accession to the porcelain exhibits of the Museum. A set of three vases of Chelsea porcelain decorated in the Sèvres manner with subjects after Boucher on a claret-coloured ground, a rare mirror and stand with relief scrollwork, two peacock-feather plates, and two large tureens testify to the pre-eminence of this the most sumptuous of all English wares of the eighteenth century. Biscuit groups after Angelica Kauffmann and a set of gold-striped blue vases of Chelsea-Derby porcelain symbolise the more sober taste which came into fashion towards the close of the century. Two hexagonal vases with Japan patterns and salmon-coloured ground and three tea-services from the Worcester factory are typical of the good workmanship which is so praiseworthy a feature of its productions. A number of Bristol vases acquired from the Trapnell and other collections are interesting illustrations of the short-lived attempt to manufacture hard porcelain of the Chinese and German type in this country. Mr. Allen's collection is certainly one of the most important of English porcelain formed in recent years. It is hoped that a catalogue will be ready shortly. In the windows of the adjoining room (No. 136) may be seen the second of the two loans now under notice—a series of small medallions and panels of English stained glass lent by Mr. A. L. Radford, F.S.A. The majority of these are of a heraldic character and date from the Tudor period. The blazoury and badges of Henry VIII. and his family are exemplified in great variety. Certain of the panels are believed to have come from the palace of Nonsuch, built by that king near Ewell, which was demolished in the seventeenth century; others were formerly at Cowick Priory, near Exeter. It would be difficult to find in the whole history of stained glass anything to surpass in ordered balance of design and harmony and splendour of colouring some of these small armorial medallions.

The Unsinkable "Delmira."—The *Shipbuilding and Shipping Record* gives an interesting account of the remarkable fortunes of the ss. "Delmira," which was attacked by a German submarine in the Channel on March 24th. After eluding the enemy for nearly an hour, the captain and crew were forced to abandon her. The Germans then went on board the vessel and placed a bomb under the forecastle, which set the forward end of the vessel on fire. The submarine then discharged a torpedo, which struck the vessel in the engine-room on the starboard side, blowing a big hole in the shell and seriously damaging the machinery, but still the vessel did not sink. The Germans then left the "Delmira" and towed the three boats containing the crew towards the English coast for an hour and a half, until they sighted the ss. "Lizzie," when the submarine left, and the crew were taken on board the "Lizzie" and landed at Sandown Bay, in the Isle of Wight. meanwhile, the "Delmira" was drifting helplessly in the Channel, the fore-end burning furiously, and in this condition was sighted by a British destroyer, which came up with her, and, considering her a danger to navigation, put some shots into her with the intention of sinking the vessel. The ship still remained afloat, and she eventually drifted ashore on the French coast about ten miles from Cherbourg and sustained heavy bottom damage. The French naval authorities extinguished the fire and towed the "Delmira" to Cherbourg, where she was dry-docked and a large shield fitted over the hole in the engine-room made by the torpedo. After this was completed the vessel was then towed to Sunderland, all the machinery was removed to be reconstructed by the engine builders —Messrs. George Clark (Limited)—and the ship herself was towed round to the Tyne to have the other repairs executed at the dry docks department at the Wallsend shipyard. The "Delmira" was built by Messrs. Short Brothers, Sunderland, in 1905.

Wheat Supplies.—Some interesting figures are given by Mr. Alfred Akers, in a couple of articles reprinted from the *Outlook*, on "The World's Wheat and the Risk of Shortage." A very serious risk run by this country, and one which is especially dangerous in time of war, is our partial dependence on erratic foreign yields. Practically the whole of the world's exportable surplus comes from seven countries, in these proportions. Russia, 19·4 per cent., Rumania, 8·1 per cent.; United States, 20 per cent.; Argentina, 16 per cent.; Canada, 19·4 per cent.; India, 9·2 per cent., and Australia, 7·2 per cent. A few others combined contribute the small remainder. The annual variability of the yield in many of these countries is apt to be overlooked. For instance, the Canadian wheat crop for 1914 is estimated at nearly one-third less than that for 1913, showing a deficiency of more than one-half in the average Canadian exportable surplus. The Australian crop is not expected to provide more than enough for local consumption and seed; the Argentina crop of 1913 14 was only up to 50 per cent. of expectation in many provinces; while Indian yields of corn are always precarious, though, fortunately, they are becoming less so. On the other hand, the British yield of wheat per acre is remarkably regular, and in view of this fact Mr. Akers pleads for a substantial increase in the British area under this crop. At present, out of 47,000,000 acres of cultivated land in the kingdom, only 1,800,000 grow wheat. 8,500,000 acres would, at the present average yield, produce all the breadstuffs which we at present require.

Correction.—In the table of "Volumes of Vapour from Petrol Hydrocarbons," in Professor Vivian B. Lewes's Fothergill Lecture on "Motor Fuels" (*Journal* of July 9th, 1915, p. 763, col. 1), the cubic feet of vapour per lb. of nonane were given as 22·9 instead of 2·29.

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FRIDAY, JULY 23, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

CHAIRMANSHIP OF COUNCIL.

On Monday, the 19th inst., at their first meeting in the new session, the Council elected Mr. Dugald Clerk, D.Sc., F.R.S., Chairman for the ensuing year.

SPECIAL WAR LECTURE ON "FIELD TELEPHONES."

The Council have arranged with Mr. Charles R. Darling, A.R.C.Sc.I., F.I.C., Lecturer in Physics at the City and Guilds Technical College, Finsbury, to give a special lecture on "Field Telephones," with experimental illustrations, at 4.30 p.m. on Wednesday afternoon, July 28th.

The lecture will be open to all Fellows of the Society, who can admit their friends personally, or by the usual tickets. Any Fellows requiring further tickets can apply to the Secretary, who will furnish them with any number they may desire for distribution. Tickets will also be issued gratuitously to any persons interested in the subject who may apply to the Secretary.

LECTURES ON "MODERN MUNITIONS OF WAR."

On Wednesday afternoon, July 21st, Professor Vivian B. Lewes, F.I.C., F.C.S., delivered the third and final lecture of his course on "Modern Munitions of War." The subject of the lecture was "Poison Gases and Incendiary Bombs."

On the motion of the Chairman, the Hon. Richard Clere Parsons, a vote of thanks was accorded to Professor Lewes for his interesting course.

The lectures will be printed in the *Journal* during the summer recess.

EXAMINATIONS.

The results of the Intermediate Examinations (Stage II.) held in May were sent to the centres on the 16th inst. The results of the Elementary Examinations (Stage I.) will be published next week.

The time-tables for the 1916 Examinations are printed on pages 790 and 791. The first examination will be held before Easter, commencing on April 10th and finishing on April 19th. The second examination will be held before Whitsuntide, commencing on May 29th and finishing on June 7th. The time-tables have been rearranged, and the subjects taken on the first four days of the Easter examination will be taken on the last four days at Whitsuntide, and *vice versâ*.

It will be seen that the following languages, Portuguese, Russian, Swedish, Chinese, Japanese, Hindustani, Dutch, Arabic, and Danish and Norwegian, appear in the Whitsuntide examination time-table only.

The total number of candidates examined in all these languages during the past six years amounts to 400; of these 185 were in Portuguese, 72 in Russian, 64 in Danish and Norwegian, and 44 in Swedish, while none of the other languages attracted more than ten candidates. So far as can be estimated, the cost to the Society for Examiners' fees, printing, etc., for the examinations in these languages for the years 1909 to 1914 inclusive, amounted to something like £450, while the amount received in fees was £50. It is therefore evident that each candidate costs the Society something over £1, and whether the value of the work done is equivalent to the expenditure is certainly doubtful. The old regulation, which has never been carried into effect of recent years, that no examination shall be held in a subject for which less than 25 candidates present themselves will, therefore, in future be enforced. Even under these circumstances the Society will suffer a loss, but at all events the loss will be lessened.

EXAMINATION TIME TABLE FOR APRIL, 1916.

	Monday, April 10. (7–10 p.m.)	Tuesday, April 11. (7–10 p.m.)	Wednesday, April 12 (7–10 p.m.)	Thursday, April 13 (7–10 p.m.)	Friday, April 14. (7–10 p.m.)	Monday, April 17. (7–10 p.m.)	Tuesday, April 18. (7–10 p.m.)	Wednesday, April 19. (7–10 p.m.)
Advanced Stage	Book-keeping. Précis-writing.	German. Commercial Law.	Accounting. English. Typewriting. (7.30 to 10 p.m.)	Shorthand (140 and 120 words per minute). (7.15 to 10 p.m.)	French. Company Law. Economic Geography.	Theory and Practice of Commerce. Spanish.	Banking. Economic History.	Economic Theory. Arithmetic.
Intermediate Stage	Typewriting. (7.30 to 10 p.m.) Economic Geography.	Book-keeping.	French. Economic Theory.	English.	Commercial Correspondence and Business Training. Spanish.	Arithmetic. Economic History.	Shorthand (100 and 80 words per minute). (7.15 to 10 p.m.)	German. Theory and Practice of Commerce. Précis-writing.
Elementary Stage	French.	Typewriting. (7.30 to 10 p.m.)	Spanish. German.	Shorthand (50 words per minute). (7.15 to 10 p.m.)	Arithmetic.	Book-keeping.	Economic Geography. English.	Handwriting and Correspondence.
Music			Harmony.					Rudiments of Music.

EXAMINATION TIME TABLE FOR MAY AND JUNE, 1916.

	Monday May 29. (7–10 p.m.)	Tuesday, May 30 (7–10 p.m.)	Wednesday, May 31 (7–10 p.m.)	Thursday, June 1 (7–10 p.m.)	Friday, June 2. (7–10 p.m.)	Monday, June 5. (7–10 p.m.)	Tuesday, June 6. (7–10 p.m.)	Wednesday, June 7. (7–10 p.m.)
Advanced Stage	French. Company Law. Economic Geography.	Theory and Practice of Commerce. Italian. Spanish.	Banking. Economic History.	Economic Theory. Arithmetic. Portuguese. Russian. Swedish. Chinese. Japanese. Hindustani. Dutch. Danish and Norwegian.	Book-keeping. Précis-writing.	German. Commercial Law.	Accounting. English. Typewriting. (7.30 to 10 p.m.)	Shorthand (140 and 120 words per minute). (7.15 to 10 p.m.)
Intermediate Stage	Commercial Correspondence and Business Training. Spanish.	Arithmetic. Economic History.	Shorthand (100 and 80 words per minute). (7.15 to 10 p.m.)	German. Theory and Practice of Commerce. Précis-writing.	Typewriting. (7.30 to 10 p.m.) Economic Geography.	Book-keeping.	French. Italian. Economic Theory.	English. Portuguese. Russian. Chinese. Swedish. Japanese. Hindustani. Dutch. Danish and Norwegian. Arabic.
Elementary Stage	Arithmetic.	Book-keeping.	Economic Geography. English.	Handwriting and Correspondence.	French.	Typewriting. (7.30 to 10 p.m.)	Spanish. Italian. German.	Shorthand (50 words per minute). (7.15 to 10 p.m.)
Music				Rudiments of Music.			Harmony.	

PROCEEDINGS OF THE SOCIETY.

FOTHERGILL LECTURES.

MOTOR FUELS.

By Professor Vivian B. Lewes, F.I.C., F.C.S.

Lecture III.—Delivered March 1st, 1915.

"Cracked" Spirits.

Thorpe and Young showed that by "cracking" a definite hydrocarbon belonging to the higher members of the paraffin series under a pressure of 25 lb., and at a temperature that could only have been as much above its boiling-point as was represented by the increase caused by the pressure employed, it was possible to split it up into the whole series of paraffins and olefines containing a less number of carbon atoms in the molecule than the body taken. Further, they showed that the two series of hydrocarbons were present in the portion of the resulting oil boiling below 100° C. in nearly equal proportions, but that in the higher fractions the amount of saturated to unsaturated hydrocarbon became higher and higher.

Important as these conclusions are, a study of the original memoir shows other deductions that may be made from the results of their experiments of quite as great value.

In the formation of simpler hydrocarbons from more complex, the important factor which governs the course of the reaction and the nature of the new compounds is the degree of temperature employed. This is not given in Thorpe and Young's paper; but the specific gravity of the paraffin-wax and also its melting point were carefully determined, and the pressure under which it was distilled was 25 lb., and from these we know that the temperature used in the action could not have been much over 300° C., and it would be quite safe to say between 300° C. and 400° C. At this temperature the reaction would be a dissociation, not a decomposition, the difference between the two being that in the former case, under favourable conditions, recombination would take place between the products to form the original body, whilst in a decomposition the products remain separate.

That it is dissociation acting in this case is shown by the fact that if the paraffin-wax was heated in a straight sealed tube for twelve hours no change in melting-point or composition ensued, but when transferred to a bent tube and distilled backwards and forwards six times it became completely liquid.

In the straight tube, all at the same temperature, there was no separation by condensation of the dissociated parts of the molecule in the vapours, and they recombined, but in the bent tube each distillation and separation built up lighter compounds, which were not dissociated again at the temperature and pressure capable of divorcing the groups of the heavier molecules. The fact that a temperature that will dissociate a heavy molecule is insufficient to break up lighter ones is made clear by the authors, who took the fraction of oil boiling at about 255° C. from a previous make of cracked hydrocarbons and distilled it backwards and forwards in the bent tube twenty-one times without altering its boiling-point or bromine absorption. Indeed, they went so far as to say: "It appears that only paraffins boiling at an extremely high temperature and those usually solid under ordinary conditions are thus susceptible of decomposition. The readiness with which they yield liquid hydrocarbons appears to depend upon the complexity of their constitution."

They were undoubtedly right *for the temperatures they employed*, but neither they nor the many who have devised cracking processes since have grasped fully the fact that every simplification of the hydrocarbon molecule requires a higher temperature for its further dissociation, and that where an oil is cracked, the largest portion of which distils at 200° C., one must use a temperature liable to overcrack, *i.e.*, decompose the fractions of oil distilling at 300° C., with the resulting formation of tar, gas, and choking with carbon.

Starting with the assumption that Thorpe and Young's experiments were carried out at a temperature probably about 300° C. to 400° C. and under a pressure of 25 lb., we have the conditions under which a heavy paraffin hydrocarbon of uniform or nearly uniform composition could be cracked into liquid hydrocarbons with but little gas and no residue of carbon, and as at the present time the great interest of such processes is in the percentage of motor spirit boiling below 150° C. that can be obtained from the original material, it is important to note that from the figures given there must have been a conversion of 19 per cent. of the wax into spirit—an excellent result even as compared with what can be done in one cracking by some of the modern processes.

It seems from the memoir that neither the separation of carbon nor formation of tarry residues took place, as preliminary experiments

are described in which paraffin-wax in a bent tube was distilled in a gas-combustion furnace from the end containing the wax to the cooled end; then the tube was reversed and the distillation repeated, and after a dozen distillations the distillate remained perfectly liquid, and consisted of a mixture of saturated hydrocarbons and olefines. This is evidently the primary action that takes place, and in the commercial application of the process complications in the results are introduced at once by the use of a mixture of hydrocarbons instead of a simple compound, so that to get dissociation of the main fractions decomposition of the higher ones has to be faced.

Directly decomposition begins to take the place of dissociation the fact is made manifest by the evolution of gas—one cannot have satisfactory conversion unless some gas is being evolved. That is to say, the temperature must be high enough to bring about incipient decomposition in the heaviest molecules in order to ensure dissociation in the most abundant and lighter compounds; but excessive gas means not only heavy waste of hydrocarbons, but thickening of residue by tar and deposition of carbon.

The amount of gas evolved, when it can be measured, is as good an indicator of the correctness of the temperature as an analysis of the gas is of the character of the conversion. The quantity and character of the gas evolved, of course, will vary with the oil used, but as long as it is a mineral-oil residue the results are fairly concordant for the same temperatures.

The class of oil most often employed for cracking work is the fairly cheap grade after the benzene and lighting oil cuts have been taken off, such as "solar distillate," and an experiment that affords a good deal of information is the simple cracking and decomposing of such oil by dropping it into an iron retort heated to definite and carefully maintained temperatures, in much the same way as if the object was to make oil gas. Under these conditions the volume of gas evolved indicates when decomposition commences and its degree, whilst an analysis of the gas shows the ratio of saturated to unsaturated hydrocarbons.

Thorpe and Young showed that when the action was dissociation only, *i.e.*, the perfect condition we desire to aim at, the proportions of the saturated and unsaturated hydrocarbons boiling below 100° C. were nearly equal; and I find that when decomposition has just started the same thing is noticed in the gas, whilst as decomposition increases with temperature, more rapidly with unsaturated than with saturated hydrocarbons, the ratio of these to the unsaturated rapidly increases as decomposition becomes excessive.

Taking a "solar distillate" oil with a gravity of 0·865 and a flash-point of 149° F., and allowing it to drip slowly into a retort heated to a known temperature, no decomposition will show until about 400° C., when gas will begin to be evolved, and will increase in quantity rapidly with rise of temperature until about 1000° C. is reached, when it is loaded with soot, and all the hydrocarbons are undergoing rapid decomposition. The volume of gas evolved per gallon of oil treated is shown by the following table:—

Temperature of retort—	500° C.	700° C.	900° C.	1000° C.
Cubic ft. of gas per gallon—	12	60	72	84

The analyses of the hydrocarbons in the gas given off at various temperatures are:—

	500° C.	700° C.	900° C.	1000° C.
Unsaturated hydrocarbons .	39·13	36·56	36·55	22·04
Saturated hydrocarbons .	42·41	49·45	49·45	54·83
Acetylene . . .	0·05	0·08	0·38	0·46

For such an oil cracked without pressure 500° C. would be the temperature likely to give the best results, as we see from the table that only 12 cubic feet of gas per gallon are being formed, so that the wastage of oil is small, whilst the proportions of saturated and unsaturated hydrocarbons are near together, and reflect the proportions in which they would be formed in the liquid residuals.

Having thus fixed the best temperature under ordinary pressure for the particular oil with which we have to deal, the next point to consider is how far pressure will aid us in carrying out the process on a commercial scale.

Cracking under pressure acts advantageously in two ways. In the first place, it increases the boiling-point and the temperature of decomposition, so that a temperature of 600° C. might be employed without any more wastage than at 500° C., and with a considerable increase in the conversion; whilst, in the second place, it causes the absorption and polymerisation of some of the nascent fragments of heavy molecules, and so adds to the volume recovered, giving a total conversion on the first cracking of 20 to 30 per cent.

It must not be supposed for a moment that because Thorpe and Young found the products

of cracking a simple paraffin hydrocarbon at a suitable temperature to be only olefines and simpler members of the paraffin series, the same easily traced compounds constitute a modern cracked spirit. We have been forced by commercial considerations to deal with a residue oil containing nearly all the members of the paraffin series from nonane upwards, and whilst we have been regulating our conditions of working to suit the largest fraction of the oil, we have been decomposing the higher fractions and undercracking the lower, with the result that the spirit obtained contains not only the primary products of dissociation, but also the secondary products of their further decomposition and interactions.

In the residues we find not only all the analytic products of the dissociation boiling above 150° C., but also the synthetic results of many polymerisations and secondary reactions that yield heavy compounds, asphaltic bodies, and, if decomposition has gone too far, tar pitch, and carbon.

The interesting class of hydrocarbons known as naphthenes is largely represented both in the spirit and residues, and as these on decomposition break up into hydrocarbons of the aromatic series, if the temperatures used have been excessive, traces of these are also found, and the "cracked spirit" is a mixture of far greater complexity than the ordinary petrol.

So far I have dealt with the cracking of oil by heat aided by pressure, and before passing on to consider the many attempts that have been made to obtain improved results by modifications of the process, it will be well to see what has been done by "cracking" alone.

The earlier attempts to crack the heavier fractions of oil took the form of distilling under pressure, and by the use of a relief valve condensing at ordinary pressures, but in 1889 Sir James Dewar and Sir Boverton Redwood patented an apparatus for conducting both operations under pressure, so doing away with the objectionable feature of checking the passage of the vapour to the condenser, which must of necessity cause irregularity in the distillation, whilst condensation under pressure gives the enormous advantage that the lighter vapours, such as pentane, come down with the spirit instead of to a large extent escaping, which must always be the case with condensation at ordinary pressure and temperature. Unfortunately, the process was twenty years before its time, light spirit was a drug in the market, and commercial failure was the result; but what the success would have been had the patent been taken in 1909 is shown by the enormous amount of cracked spirit being made in America by the servile imitation of Dewar and Redwood's process employed by the Standard Oil Company. This fact emphasises the mysteries of patent law and the importance of a huge capital.

In a process which has been exploited here recently, and plant to carry out which is being erected, the oil is forced under pressure through a coil of heated tube, the pressure being kept sufficiently high to prevent the separation of any gas, and the diameter of the tube being so arranged in relation to its length that every part of the oil is subjected for a considerable time to the superheating. The tube is continuous, and after the cracking coil is formed into a second coil, water-cooled, in which the oil now containing the fractions of lowered boiling-point and dissolved vapours is brought back to a low temperature, and finally escapes through a loaded valve into the receiver, the light fractions being separated by subsequent distillation and the residual oil returned for further cracking. In this way, the first run through gives a conversion of about 22 per cent. of the original oil into fractions boiling below 150° C., whilst running through five times with removal of the light fractions after each run is claimed to give over 80 per cent. conversion.

In considering the commercial aspect of such processes the point that has to be watched the most carefully is the cost of handling, fuel, and power. At the oil-fields, where residual oils cost a penny or less per gallon, it may pay handsomely so to treat the oil as to get the highest possible conversion; but over here, with the oil costing at its cheapest 2½*d.* or 3*d.* per gallon, and the spirit having to be produced at the works at 8*d.* in order to give it a chance of competing successfully with petrol, it is clear that unless the process is carried out on a very large scale, establishment costs, labour, fuel, etc., will soon eat into the profits, and as each run with residues shows a smaller and smaller conversion, not to mention the increased tendency of choking the coils, there is an economic limit to the recovery that is quickly reached.

A very interesting phase of the motor-fuel question is the combination of cracking with the recovery of very light spirits from the gases escaping from the oil-wells. For some years past "wet" gases, *i.e.*, natural or well gas containing the vapours of pentane and

hexane, have been cooled and compressed in order to condense the highly volatile hydrocarbons, and these in turn dissolve propane and butane, which are gaseous under atmospheric conditions; this gives a liquid of very low specific gravity which is too "wild," *i.e.*, evaporates too quickly, for motor work, but which, mixed with grades of spirit too heavy to work well as a motor fuel alone, gives the necessary vapour pressure and elasticity in running, whilst the heavy spirit retains the more volatile portions and prevents over-evaporation. In the States the residue oils are largely cracked to a heavy grade of spirit, and this, when touched up with the lighter spirit, makes an excellent motor fuel that can be sold cheaply, and is used extensively for agricultural work in the West.

Very much on these lines, but elaborated in a beautiful way, is one of the most interesting and successful processes that have been brought forward for the manufacture of motor fuel from heavier grades of oil. At a meeting of the Petroleum Technologists, held on February 18th last, Mr. W. A. Hall gave a full description of his process, and I would recommend those interested in the subject to consult the original paper. In brief outline the system adopted is as follows:—

"The oil is fed, at a rate exceeding seventy gallons per hour, through inch tubes of not more than 300 ft. in length, under 50 lb. to 75 lb. pressure, and so throttled that the speed of the vapour through the tubes exceeds 5,000 ft. per minute. The oil is first vaporised in a coil, preheated in the flue by the waste heat of the products of combustion from the furnace, so that it enters the cracking tubes at a high rate of speed. The speed is so great that very little deposit can be formed in these tubes to choke them and interfere with the cracking action; but, as the passage of the vapours through the tubes occupies only about three seconds, no very extensive cracking occurs, as is proved by samples extracted at these points. The temperature read on a pyrometer, its thermo-couple being located in the centre of the tubular nest, is about 550° C.

"The vapours issuing pass into a vertical pipe of twelve or more inches internal diameter, and about 12 ft. high, entering it through a very confined space acting as a throttle, and preferably impinging against a baffle in the large pipe, so that the speed of flow is instantly reduced from about 6,000 ft. per minute to a very nominal rate. This converts the energy of speed into that of heat, a sort of degrading action, much the same as takes place in a throttling calorimeter, the temperature actually increasing some 30 C., notwithstanding the expansion due to a reduction of pressure from 50 lb. or 75 lb. to about atmospheric. Hence we have in this large pipe, which is well insulated, a temperature well above that existing in the inch tubes of the cracker, and as the speed through this large pipe is comparatively slow, a large amount of cracking therein takes place with no extraneous application of heat, affording no chance for a superheating of the vapours to a temperature higher than that at which cracking takes place.

"By this method the interior of the mass is hotter than the exterior wall of the container, and all the vapours in their upward passage are working towards a cooler condition, thus preventing local superheating, which has always produced the largest amounts of fixed gas from what would otherwise have been condensable product of the character most desired in motor spirit.

"The pipe is filled with small pieces of thin tubing, which present an enormous surface and are found to collect any carbonaceous deposit.

"One might think that this very large chamber with all its surfaces, and with the slow passage of vapours through it, would act as a dephlegmator rather than a cracker, but in actual practice, even with oils of a gravity exceeding 0·960, and some very high-boiling fractions, no liquid condensate has ever been collected from the bottom and the higher the rate of feed of oil, at the same temperature in the cracker, the higher is the temperature in this secondary cracker.

"The actual temperature of the vapour in the lower portion of this receptacle may exceed the external temperature of the tube near its exit, but inside the furnace by about 30 C.

"From this receptacle the vapours pass through dephlegmators that separate all fractions boiling below the chosen point of cut, and the vapours and gases passing on are conducted without further condensation, and at a depression, into a mechanical compressor working under 70 lb. to 100 lb. per square inch, and then condensed through a cooler under that pressure. The object of the compressor is two-fold. Firstly, and of least importance, it is a means of drawing these vapours at substantially atmospheric pressure through the secondary cracker and the dephlegmators; and, secondly, it is a means of chemically attaching to the

condensable liquid the gases that would otherwise be permanent.

"That any chemical combination between such gases and liquids could thus take place has provoked much question and scepticism, and has led to very extensive tests. It was generally contended that its function could be only that of creating a solution of a gas in a liquid. That an actual and important chemical reaction does take place has now been established to the satisfaction of some of our best experts."

So far I have dealt with the cracking of oil alone, but during the past ten years several processes have been devised in which steam or water has been introduced with the oil into the cracking ducts, the idea being that hydrogen from the water would affix itself to the heavy hydrocarbons and hydrogenate them into lighter hydrocarbons. To aid this action catalysts have been frequently used, nickel being the most popular.

The idea of the use of nickel as a catalyst is twenty-seven years old, as in 1888 Ludwig Mond took an English patent (12,608 of that year) in which he mentions the treatment of hydrocarbons together with steam by passing them through heated vessels containing firebrick or iron oxide, and he states that if metallic *nickel is used in place of the iron oxide, then only a moderate temperature is required.*

About 1900 Sabatier and Senderens studied the action of nickel and other metallic catalysts on the hydrogenation of oils, and in the following years there were many more patents taken covering its use. Still later there were a large number of patents taken in America by Dr. Day, Ellis, Kayser and others dealing with the use of nickel as a catalyst.

Mond, Sabatier, and Senderens all recognised that such surface action as the nickel exercised took place only at temperatures below, at any rate, 300° C., but the more recent exploiters of the idea have drifted back to the heats one would use for cracking, not for hydrogenation. It may have been my ill-fortune, but in such experiments as I have made I have got just as much and sometimes more conversion when using the oil alone as I obtained by using water or steam and nickel surfaces at the temperature prescribed (about 600° C.).

I strongly suspect that at the temperatures employed the steam and water play a purely mechanical part, and simply break up the oil volume and hurry the cracking liquid through the hot zones, incidentally forming magnetic oxide with the iron of the ducts, whilst the hydrogen so liberated does not hydrogenate the oil, and is found in the gas. The nickel seems only to act at this temperature in reducing the volume of flowing oil into thin streams, and by its conductivity helping the transmission of heat to the oil.

All cracked spirits differ from petrol in the sickly alliaceous odour they possess; which is the more disagreeable is purely a matter of taste. This smell is due to certain unsaturated hydrocarbons, and to remove it by acid treatment would not be commercially possible owing to the loss in volume that would be incurred: but there is one advantage that may be placed to the credit of the "cracked" fuel, and that is that you nearly always find it 10 to 20 per cent. more powerful than petrol, as its specific gravity for a given range of fractionation is always higher, and so there is a greater weight to the gallon.

One of the troubles of the maker of cracked spirit is that it often has a yellowish colour that is difficult to get rid of; this is due to a naphthene hydrocarbon "cyclopentadiene"—which polymerises on standing for some time in light, forming resinous bodies, and causing sticking of valves in use. Indeed, the presence of very high percentages of unsaturated hydrocarbons (shown by bromination) frequently gives rise to this trouble.

I have already pointed out the great complexity of the mixture of hydrocarbons in such spirits, and it is often found that amongst the residues, especially when water or steam has been used in the cracking, there are oils that have distinct drying properties, and if used fresh make quite decent varnishes and vehicles for colours. Indeed, a patent was applied for in 1912 for converting heavy non-drying hydrocarbon oils into drying oils. As far as I have been able to trace the action that gives rise to this it is that some of the higher members of the acetylene series, such as isoprene, C_5H_8 (hemiterpene), are formed and then polymerise to terpenes, $C_{10}H_{16}$, which on standing, especially in light, gradually absorb oxygen and become converted into resinous bodies, the drying power being then reduced and the colour of the oil darkening. There is very little doubt but that some isoprene is formed, and as this is an excellent starting-point for the synthesis of artificial rubber, we may some day see the cracking of oils providing tyres as well as fuel to the motor-car!

The chemistry of the tars and residues from cracked oils offers a field for research every whit

as fascinating as coal-tar, and as the residues contain not only naphthenes but also heavy hydrocarbon molecules capable of being broken up into naphthenes by further and higher temperatures, it is worth consideration as to whether they could not be used profitably for the production of aromatic hydrocarbons, which are formed by the shedding off of hydrogen by the naphthene molecule. At the present time the demand for toluene is increased enormously for the manufacture of trinitrotoluene for explosive purposes, whilst if a State-aided attempt is to be made to capture the dye industry the demand for aromatic hydrocarbons—benzene, toluene, xylene, naphthalene and anthracene—will for some years be far in excess of the supply.

It will be remembered by many that in 1885, when the demand for benzol was high, Nobel Brothers, Liebermann, Burg, Salzmann and Wichelhaus investigated the possibility of obtaining aromatic hydrocarbons from petroleum residues, and obtained excellent results. The slump in the price during the past twenty-five years, which at one time brought benzol and toluol down to something like 6*d*. a gallon, led to these processes being abandoned, although I believe the preparation of aromatic hydrocarbons on a small scale is still practised from Russian petroleum.

Although the usage of the last fifteen years causes us instinctively to think of a motor-bus or trolly as a vehicle driven by an internal-combustion motor, everything points to steam-driven engines shortly challenging their supremacy, and probably ousting petrol for commercial haulage.

The opening years of the last century saw the inception of the mechanically propelled carriage running on the public roads, and about 1825 steam-driven stage-coaches were actually at work. Prejudice and legislative restrictions, however, offered but little encouragement, and in 1865 the Locomotives on Highways Act prescribed that the maximum limit of speed should be four miles an hour, with a man in front bearing a red flag; and although this was evidently intended to apply only to heavy traction, an appeal to the Court of Queen's Bench in 1881 placed every type of self-propelled vehicle under its restrictions, and killed all attempts at development until the repeal of the Act in 1896, by which time Germany and France, free from grandmotherly care, had got a lead in the development of the motor industry that took this country fifteen years to overtake. This forms an excellent example of the sort of "State-aid" our industries receive.

It was the invention by Daimler in 1885 of a motor using petroleum spirit and the perfection and application of it to vehicles by the French firm of Panhard and Levassor, who purchased Daimler's patents, that led to the remarkable developments that have revolutionised entirely our ideas on travel and traction and made the motor-car a necessity to civilised life. Great as has been the growth of the motor industry in the last ten years, its advance will be even more rapid in the next ten, but the most marked increase will be for what may be called commercial vehicles. Many large firms have already replaced horse haulage by the motor lorry and van, but the smaller traders, although they have realised the importance to them of following suit, have held back not so much from a desire to avoid the initial cost as from a fear of what the working expenses might increase to. They have noted the rapid advance in the price of petrol, and have listened to the prognostications of further rises in price to come, and have decided not to sell their horses and scrap their carts and vans until some guarantee was forthcoming that in the future their running costs would not be millstones round the neck of their business. The proposed substitutes for petrol have not yet made any great show on the market, with the exception of benzol, and its price is following perilously close in the wake of petrol, whilst the supply in the early future seems far from certain.

During the eighteen years that the motor-car industry has been advancing with such enormous strides, attention has been concentrated almost entirely on perfecting the internal-combustion engine for use with petrol, but steam-driven vehicles, especially for traction, have always had supporters who laboured to bring them to a degree of perfection that would enable them to compete economically with petrol for heavy work, and in this they were successful, but the first idea of steam ever entering into competition with the petrol-driven passenger vehicle came when, in 1903, the Clarkson steam buses appeared on the road. With the earlier steam-driven locomotives for traction, coke or other solid fuel was employed with hand-stoking, fire clearing, etc., and when automatic firing was attempted, jamming in the fuel feed, clinker and other troubles made their appearance, the result being that in the steam-driven motor-bus oil fuel burnt in suitable burners was

employed, and we all know how satisfactory the result has been.

During the past year, however, a further development has been introduced by the successful adoption of a new form of coke-fired boiler and fuel feed, designed by Mr. Thomas Clarkson, the managing director of the National Steam Car Co., in a motor-bus fitted with it, which has been running for some months past in regular work with the other vehicles belonging to the line, and has given perfect satisfaction.

Another similar boiler was fitted to a motor lorry and submitted to the Royal Automobile Club, who ran it under their open competition rules to Brighton and back on two consecutive days and on the results of the trial the firm was awarded the Dewar Trophy for the most meritorious performance in automobile engineering during the year ended October 15th, 1914, Mr. Clarkson having earlier in the year been awarded a silver cup by the Commercial Motor Users' Association. The fuel used was broken coke passing through a 2-in. mesh and held by a 1-in. mesh, and on the first day the consumption worked out at 0·62 lb. per ton mile gross, and on the second day 0·56 lb. per ton mile, or an average of 0·59 lb. With coke at 18s. per ton, a price at which the Gas Light and Coke Co. will supply any quantity carefully graded, this works out at about 17 ton miles gross for 1*d*. as the fuel cost.

In a trial of this sort, with the speed kept at an average of twelve miles an hour, and the road stoppages amounting only to thirty-two minutes on one day and twenty-four minutes on the second for a run each day of 109½ miles, the fuel consumption per mile is, of course, less than with a motor-bus in heavy traffic and with constant stops, but even under these conditions it would be safe to take ten ton miles per penny as the fuel cost.

Petrol of the grade used in a motor-bus would be contracted for in enormous quantities by the big companies at about 10*d*. per gallon, and 50 ton miles per gallon would be a good duty to obtain, so that the petrol-driven motor-bus would obtain only 5 ton miles per penny, and the fuel cost, therefore, would be double that of the steam-driven vehicle, whilst the small trader, paying 1*s*. 4*d*. per gallon for petrol, would obtain only 3·1 ton miles a penny, or less than one-third the power.

Gas coke is a home production the price of which is not likely to be affected in the same way as the price of petrol, the supply of which is in the hands of a few powerful and wealthy corporations. The price of all fuel must slowly rise as gradual depletion and increased consumption render the needed supplies more difficult to obtain, but the small trader will feel that he need fear no sudden rise in fuel cost of the character that for the past few years has prevented him adopting motor vehicles.

The newest type of boiler consists of a forged steel cylinder or drum, closed at the lower end, and fitted with a cover which may be removed for cleaning purposes. The cylinder is placed practically within a firebrick casing, and on the outside of the cylinder a large number of generating tubes project, the tubes being relatively short and of larger diameter.

This form of generating tube has superseded the horseshoe pattern which was formerly employed on the Clarkson steam motors as being easier to clean and repair.

It was first thought that no proper circulation of water could take place in these tubes, as only one end is open, but tests conducted with a glass tube prove that there is a good circulation. The circulation occurs in two phases. Below the boiling-point there are two currents in each tube, a lower current from the drum into the tube. As the water becomes heated it rises into the upper stratum and returns to the drum. The two currents in opposite directions may be clearly demonstrated by the addition of fine sawdust to the water. After the water has been raised to boiling-point a different circulation occurs. The tube being full of water at boiling-point, a further absorption of heat causes a copious stream of bubbles to flow back to the drum, thereby preventing further admission of water into the tube until the ebullition abates, owing to the water in the tube becoming used up. The tube never becomes dry, but is about one-third full at the lowest point when steaming rapidly at atmospheric pressure. The water in the boiler then rushes in and completely fills the tube, and the same cycle of operations is repeated. At atmospheric pressure the cycle occupies from three to five seconds. It is in the nature of pulsating circulation, and, incidentally, this is useful in assisting to keep the tubes clean. It has been observed that when a quantity of sawdust is placed in the far end of a tube it is rapidly dispersed by this action, and although it was anticipated that this might give rise to irregular steaming, and possibly cause priming in the boiler, no trace of this has been observed. The boiler steams remarkably well, and, if anything, better than the generator fitted with horseshoe tubes.

The firebrick casing which surrounds the boiler is enclosed in a sheet steel case, which in turn is surrounded by coke bunkers. There is a large shute on opposite sides of the grate, but although the base of the shute slopes at an angle of 30°, this is insufficient to convey the coke on to the grate, so push-rods or pokers are used, which slowly reciprocate and advance the coke into the combustion area *pro rata* with the combustion of the coke on the grate.

With regard to draught, where a chimney is permissible this is by far the best arrangement, and the natural draught is usually sufficient. For increasing the rate of steam an induced draught is provided by a steam jet in the base of the funnel. The use of a funnel is permissible on practically all classes of motors for the conveyance of merchandise, and also for single-deck omnibuses, but when passengers are carried on the roof a funnel cannot be employed. In this case the products of combustion are drawn underneath by a steam injector, and discharged at the rear of the vehicle on the offside, which, in the same way, has the exhaust of an internal-combustion chassis.

In conclusion, it seems a reasonable inference that the increasing activity in the production of petrol substitutes, with the use of benzol for motor-car work and the advent of new forms of steam-driven motors for commercial traction, will so ease the demand for petrol as to prevent any further rise in the price, whilst as soon as the depletion in the production of crude oil becomes a serious factor, alcohol will be ready to take its place and be available in any desired quantity to the end of time.

MUNITION METALS.

An interesting article is contributed to *Nature* by Professor H. C. H. Carpenter, in which he compares the resources of the Allies and the enemy countries in respect of metals which are regarded as essential for war purposes. The position is finally summed up as follows:

Of the ten munition metals the enemy countries can certainly produce five without having recourse to imports, viz., iron (the basis of the various steels used for war purposes), manganese, chromium, zinc, and lead; on the other hand it is doubtful whether they can produce sufficient nickel, copper, aluminium, tin, and antimony from domestic ores. In view of the fact, however, that they prepared for this war with extreme care and foresight, it may safely be concluded that large stocks, either of ores or the corresponding metals, or both, will have been accumulated in those countries. However confident the Higher German Command may ostensibly have been of a rapid victory, they will quite certainly have laid their plans to wage a prolonged war if it should prove to be necessary, and such plans will have included the accumulation of munition ores and metals of which their countries produced an insufficient amount. There is, accordingly, no adequate reason for concluding that the enemy countries are likely—in spite of the prodigious scale upon which the war is being conducted — to run short of metals which are essential for war purposes for some time to come. Moreover, it may safely be concluded that their technical metallurgists will have been mobilised in the direction of discovering substitutes for any of the above metals of which a shortage is liable to occur in a long war.

The Allies for their part can produce from their own resources all the iron, manganese, nickel, chromium, tin, and most of the aluminium they require, their command of the seas enables them to obtain, principally from the United States, their deficiencies in aluminium, copper, and lead. China furnishes the requisite antimony. Zinc is the only important munition metal of which there is a shortage, in spite of the great speed with which the American furnaces are being operated. Wherever it is possible to substitute another metal for zinc, it is of national importance that it should be done.

MARINE MOTORS FOR CHINA

Some information concerning the demand for marine motors in China is afforded by a recent report by the United States Consul at Swatow. He points out that although this part of Kwangtung Province is not so liberally favoured with natural waterways as some other sections nevertheless most of the chief centres of its more populous districts are accessible by water, and it is to this fact that Swatow owes its position among the ports of China. The streams afford the cheapest and most convenient means of transportation, available for both cargo and passengers. Boating for pleasure is not indulged in, and consequently when a Chinese buys a motor or a motor-boat it is with the intention of putting it to commercial use. For this market therefore, all engines should be of the heavy-duty type; they must burn kerosene or fuel oil, as gasolene is often difficult to procure and is very expensive; and they should have few moving parts and should be simple to operate.

There are no facilities for building modern water craft of any kind here, the power launches in use at Swatow having been constructed at Hong-Kong. Chinese buyers have no knowledge of internal-combustion engines, and consequently the selection of the motor is usually left to the builders of the boat. This condition of affairs would indicate that for such craft as are constructed at Hong-Kong manufacturers will have to get in touch with builders at that place if they desire to share in this market. The Consul states that for the present there are no schemes under contemplation for

increasing the fleet of motor launches in this district to his knowledge, but he is of opinion that it is only a matter of time until most of the steam launches will be replaced by motor ones, and also that new services will be established. Further, it will be in motor craft, constructed in accordance with local requirements, that extension will largely take place. The cost of operation, and even the initial cost, of a motor launch is less than that of a steam launch of equal capacity. As the Chinese become fully cognisant of these conditions, and as knowledge of the usefulness of motors increases, so proportionately will the demand increase.

The view is held by many that China, with its network of waterways, is bound to become a large market for marine motors, and is a field well worth cultivating. For manufacturers to gain a fair share of this trade it is necessary that they should acquaint themselves with its conditions and requirements. It must be remembered that boats to find a sale must conform to local requirements, and motors to find buyers must be suited to the uses for which they are intended.

In conclusion, it may be pointed out that the importance of manufacturers having their own representatives in some of the principal ship-building centres cannot be overestimated. If this method is not feasible, probably a plan of co-operation between manufacturers would lead to the formation of a scheme of joint representation and the establishment of their representatives at such important points as Shanghai and Hong-Kong. Were such a step to be taken, manufacturers could not only keep in touch with the development in construction of motor craft in China, but also would be in the position to offer guidance and instruction to their distributors at the smaller ports, which would prove no mean factor in developing business in a line wherein technical knowledge is required. The importance of assisting the Chinese in obtaining the requisite technical knowledge should not be disregarded.

A NEW OIL-BEARING NUT IN THE PHILIPPINES.

The Philippine Bureau of Science has recently been investigating a newly-discovered oil-bearing seed found abundantly in the Island of Catanduanes. It grows on a large tree and comes from a brown pear-shaped fruit that opens not unlike a cotton boll when ripe and emits the seeds. The seeds are rough of surface and of a dark brownish colour, about the size of a large dried prune and slightly kidney-shaped. The tree has not yet been fully identified, according to a correspondent of the American Bureau of Foreign and Domestic Commerce in Manila, but is thought to belong to the genus *Amoora* or *Dysoxylum*. Seeds belonging to other plants of that family are known to bear oil, at least of commercial value. The oil from the nuts under discussion has been tried in the manufacture of soap, and has been found to make a good commercial article. The nut or seed bears about 45 per cent. of oil, dark and fatty. This oil does not dry well, and is therefore not serviceable for paints and varnishes. It is not edible, having a bitter taste. Tradition shows that before the advent of petroleum the inhabitants of Catanduanes Island used the oil from this seed as a luminant. Since the importation of coal oil the local oil has fallen into disuse, and with no demand for it none is now expressed. In every part of the island old implements with which it was formerly manufactured for domestic use are to be found among the people. The method was to grind the seeds to a fine consistency in crude hand-mills of stone, or to grate it on rough surfaces. The resulting grindings or gratings were cooked and then put in a sack and subjected to pressure. In view of the increased use of the oil of the coconut in the manufacture of edibles, considerable interest is being taken in the new oil in the hope that it may be substituted for coconut oil in the manufacture of soap and for similar uses. The abundance of the seed from which it is expressed promises a valuable industry for the islands, in case the further experiments with the oil bear out those already made.

THE COOKING OF HAMS AND OTHER MEATS IN TINS.

Writing in the *Meat Trades' Journal*, Mr. Loudon M. Douglas, F.R.S.E., describes a new process of preserving meats — the vacuum process — which maintains the total weight of the meats, as well as preserving the flavour.

The preservation of whole hams, principally for export to tropical countries, has become quite a large industry of late, and looks like assuming larger dimensions in the future, and the new process can undoubtedly be applied to this purpose with immense advantage.

The process is in itself very simple, and can be very briefly described.

Each ham is boned out, and placed in a pear shaped tin, of a size suitable to the size and weight of the ham. The original shape is maintained, and when the boning out process has been completed some flavouring substances are lightly sprinkled over the cut surfaces of the meat, which is then pressed together, and placed in the pear-shaped tin, which it should fill tightly. The top of the tin is securely soldered on, and a small aperture, beside which a blob of solder has been placed, is left towards the narrow end of the cover of the tin The tin is now ready for treatment. It is placed in a vacuum apparatus consisting of a circular chamber, in which is a rotating platform actuated from the outside. This chamber will hold some twenty ham tins, and it is charged through a door in the side. When the chamber is fully charged this door is closed tightly, and the air of the chamber is exhausted by means of an oil-sealed pump. Obviously, in exhausting the air of the

chamber, the air will also be exhausted through the apertures on the lids of the tins. Hence the contents of the tins will, for the time being, be in a vacuum. In this condition the aperture of each tin is soldered over by means of an electric soldering bolt, which can be moved from the outside of the chamber in the vacuum, within a sufficiently large field to enable a certain amount of freedom of action inside the chamber. The operations inside the chamber are seen through a small observation window, and an electric light enables the soldering bolt to be accurately handled. Soldering having been accomplished in one tin is successfully carried out on the others, the moving platform in the circular vacuum chamber being actuated from the outside, so as to bring each tin under the field of the soldering bolt. As soon as the apertures have been soldered, a valve is opened, and air is allowed to enter the circular vacuum chamber, and it will be observed that the tops and bottoms of the tins immediately yield to the atmospheric pressure, being pressed inwards. Any tins which do not yield in this manner are faulty and have been badly soldered. The defect should be remedied, the aperture in the cover repunctured, and the tins should be treated again. The tins can now be removed from the vacuum chamber, and are ready for the next operation.

The tins are now placed in a cage belonging to a vertical autoclave, and closely packed together. The number of autoclaves used would be in direct proportion to the business to be done. The cage of the autoclave is carried by means of tackle suspended from an overhead rail. It is raised sufficiently high to clear the top of the autoclave, and is then lowered into it, the tins being submerged in a bath of hot water. The autoclave has a steam jacket, which maintains the temperature of the water inside, but when the cage has been lowered the cover of the autoclave is screwed down, and by means of steam pressure the temperature inside is elevated to 240 F., at which degree it is maintained until the hams are cooked, the length of time required varying slightly, according to weight. A large ham will take about four hours to cook, smaller ones being in proportion; the average time required being 3¾ hours. This operation of cooking the fresh hams in the tins prevents any loss of weight, and also maintains all the flavour of the meat; the advantages over the old-fashioned way are apparent. The advantage of cooking the tins *in water* inside the autoclaves lies in the equalisation of the pressure which results. In so far as the keeping properties are concerned, it may be safely stated that the hams are never likely to deteriorate, or alter in any way within the limits of several years after being tinned in the manner indicated.

Hitherto only the tinning of hams by the vacuum method has been spoken of, but the same method can be applied to corned beef, potted beef, brawn, sausages, galantines, and every other form of preserved meats. Army rations, such as sliced bacon, bacon and vegetables, or meat with vegetables, can be expeditiously and effectively canned by this method, which may be described as being applicable to the preservation of every kind of perishable food in tins. The adjustment of the vacuum chamber to packages of different sizes is a matter of detail.

ENGINEERING NOTES.

The Mont d'Or Tunnel.—To the list of notable railway tunnels in operation a new name has been added—the Mont d'Or. Robbed by the war of the publicity which so important an event would receive in normal times, the international railway link between France and Italy, *via* Switzerland—15 miles long, including the 3¾ mile tunnel—was recently opened to traffic without ceremony. To the layman the news means the shortening of the route from Frasne to Vallorbe by 11 miles, eliminating the distance to Pontarlier by the old line; but to the engineer the event marks the termination of a five years' struggle against unusual difficulties. From Frasne the double-track line extends, in the open, across a marsh where thousands upon thousands of cubic yards of material were swallowed by the ooze before a stable embankment was secured. But the trouble did not stop here, for in the tunnel excessive inflows of water were encountered, causing the collapse of sections of the roof, and threatening to stop the work. Finally an aqueduct had to be built within the bore to carry off the water. In spite of these handicaps the work was continued, and its completion is a tribute to the courage and endurance of the men who have made it. The improvements carried out over this section, and on the track generally, mean a gain of from forty-five minutes to one hour on the duration of the journey between Paris and Lausanne. The large radii of the curves are favourable for speed, and in winter the tunnels and pine forests through which the line passes are a protection against snowstorms. The motive power through the bore is steam, but the ventilation is said to be so perfect that the locomotive gases cause practically no inconvenience.

Cement-protected Steel Construction.—*The Engineer* reports that in connection with the enlargement of the Victoria terminus of the London, Brighton and South Coast Railway, a covering of nearly pure concrete to all the overbridges in the station has been adopted. The ironwork is thus protected from corrosion from the weather, and from the steam emitted by the locomotives in passing under it. At the Cortland Street ferry end of the Pennsylvania and New York City Railway the whole of the steelwork has been covered with a thin coating of sand and cement, sprayed on it by means of a "cement gun," after carefully cleaning the surfaces of the steelwork. A test-piece successfully resisted the most severe trials. It was kept in moist salt air for three days, in salt water for three days, in a temperature of [illegible] degrees

below zero for forty-eight hours, and then allowed to thaw in a warm room; then it was placed on a boiler subjected to a heat of 110 degrees for three days; then it was dropped 2 feet on a wooden floor, again on a concrete one, and showed no signs of cracking.

Turbine-electric Propulsion for Battleships.—In the *Journal of the Society of American Engineers*, Lieut.-Commander P. W. Foote, U.S.N., reviews the status of battleship propulsion by reciprocating engines, direct-connected, geared and electric-turbo units, and concludes that while turbine-electric drive has yet to be tested in a battleship installation, it promises to be superior to every competitor to an extent that will represent a distinct epoch in the engineering military efficiency of the Navy. The acceptance of the collier "Jupiter" by the Government, after tests in which this pioneer turbo-electric vessel surpassed the requirements, pointed the way to even more suitable applications of this type of equipment. The discrepancy between the economical speeds of turbines and of propellers has been so great in the past, that reduction through mechanical gearing or by the electric motor has become wellnigh absolutely essential to the kind of service demanded in the modern navy. Facility of control, economical operation at moderate speeds employed in cruising, and efficient use of power at high speed through heavy seas, are points of immense importance to battleship or cruiser. These appear to be capable of greater realisation with electric drive than with any other method of propulsion. Simplicity, the use of well-tried equipment, and service reliability, demonstrated by over a year's operation on the "Jupiter," are on its side. In manœuvring and backing the flexibility of electrical operation is of great value, and the single advantage of being able to maintain top speed in any sea with the electric drive, with no racing of propellers, might alone become the deciding factor in a naval campaign. The double "squirrel cage" induction motor exactly fulfils the requirement for ship propulsion where wide variation of loads, speeds, and operating conditions is found. Since the speeds of motors and turbo-generators depend upon the inverse relation between their poles, a reduction from the efficient turbine range of 1,200 3,600 to the efficient propeller range of 100 125 revolutions per minute is readily obtained. Electric propulsion, however, does not lend itself so well to ships of small horse-power, because the size of the motors mechanically limits the number of poles, and the speed reduction is much more limited than in ships where large motors can be used. About 5,000 shaft horse-power is roughly the present minimum for electric propulsion, mechanical reduction gearing being generally more efficient and desirable below this power unless facility of control is paramount. The electric drive permits great facility of control either from the bridge, conning tower, or any fire-control station, and in this point far exceeds the reciprocating engine, direct-connected or geared turbine. The propeller may be started, stopped, or run astern by a simple hand movement remote from the turbine room, and, similarly, turbine speeds may be electrically governed from a distance. The type of induction motor mentioned above has as high backing power as the propeller design permits, and in this way equals the reciprocating engine, and far excels the turbine mechanical-reduction gear. Throughout the electrical installation the equipment is generally operating near its rated load, which spells economy with capitals. Considering all the military and economical characteristics desired in a battleship, turbine direct-connected ships are not the equal of reciprocating-engine vessels, even when the former are fitted with cruising turbines having mechanical-reduction gears. Reduced complication, decreased weight of machinery and boilers, economy of space, and low maintenance requirements, are also closely identified with the turbo-electric drive; the danger of trouble in circuits is nominal, and the subdivision of the turbine room into water-tight compartments is greatly facilitated with the electrical installation. Constant-speed vessels have less to gain in the use of electric drive, but warships of high power are certain to find it of great value unless difficulties which are not apparent develop in service. The United States Navy Department has decided to provide turbo-electric propulsion equipment for the 32,000-ton super-Dreadnought "California," the largest battleship ever planned for that country's service, and the record of this vessel will be watched with interest by engineers and seamen the world over.

Large Submarine Engines. Both of the leading Italian Diesel-engine manufacturing firms the Fiat Company, of Turin, and Franco Tosi, of Legnano —the *Times* says, are constructing motors of the heavy oil type for installation in submarines, with a power of 1,300 B.H.P. Both designs are of the two-cycle type, and the motors built by the Fiat company, of which two have already been constructed and tested, are especially interesting. They are six-cylinder machines, with a speed of about 350 to 400 revolutions per minute, and are arranged with scavenging pumps below the working cylinders, this being a design that has been adopted by the firm for several years past. The air-compressor for the injection and starting air is driven off the end of the crank-shaft. The engine is directly reversible, the operation of reversing being facilitated by the fact that in each cylinder cover there are only two valves, the fuel-inlet valve and starting-air valve. The scavenging air is admitted through ports in the bottom of the cylinder, so that no scavenging valves of the ordinary type are necessary.

Many Inventions.—At a recent meeting presided over by Admiral Lord Charles Beresford, on the motion of Admiral Sir E. R. Fremantle, the project of a National Inventions Development Association was approved and recommended to public

support. According to the *Manchester Guardian*, it has been stated semi-officially that the authorities are not likely to be able to find time to "investigate more than a small proportion of the undeveloped inventions submitted." It is proposed, therefore, that the societies and institutes representing scientific professions should nominate representatives to serve on the Association's general committee and to appoint expert consultants and advisers in their respective branches. In the first place, all inventions, etc., will be considered by a small staff of men sufficiently qualified to sift the promising from the impracticable. Inventions of merit will be promptly referred to the expert consultants. Inventions will be patented where this is necessary, the inventor's rights being fully safeguarded. Practical tests will then be made, and if these are satisfactory the Government will be approached. It is proposed to provide rewards for notable improvements in submarines, aircraft, aerial weapons, trenching and sapping appliances, etc.

Manufacture of Cement in Queensland. In a recent number of these Notes we spoke of Greater Britain beginning to manufacture from some of her own raw material. Now we hear that Queensland has started the manufacture of cement. Owing to the shortage of German and Belgian supplies, a good deal of attention is being given to the manufacture of this material abroad, and in other places where limestone, shale, or clay and coal can be obtained of suitable quality, and in sufficient quantities to make the manufacture likely to be successful and remunerative. The Queensland Cement and Lime Company has now arranged to establish a works at Darra, near Brisbane. The plant is designed to produce about 10,000 tons of cement per annum. The complete contract for the supply and erection of the plant, which will be of entirely British manufacture, has been placed with Messrs. Noyes Brothers, Sydney. Grinding mills of the combination ball and tube mill type, and a kiln 140 feet long and 8 feet in diameter, will be erected; and these, together with all the subsidiary plant, will be electrically driven, direct-coupled wherever possible. The motors are for three-phase fifty cycles, 440 volts, and will be supplied with power from generating plant in the works, which will be direct-coupled to vertical high-speed engines. The general lay-out of the plant has been made with the expectation that the works will soon be duplicated and even further increased.

NOTES ON BOOKS.

MODERN ILLUMINANTS AND ILLUMINATING ENGINEERING. By Leon Gaster and J. S. Dow. London: Whittaker & Co. 1915. Price 12*s*. 6*d*.

The material from which this valuable volume is compiled has, for the most part, appeared in *The Illuminating Engineer*, the organ of the Illuminating Engineering Society and of the two authors Mr. Gaster is the founder and honorary secretary of that Society, and Mr. Dow is the editor of its journal. The book, however, is in no sense a reprint of previously published matter. Not only does it contain a large amount of new material, but the articles on which it is founded have been recast and rearranged into an orderly and valuable account of the present condition of artificial lighting.

It commences with a brief historical summary, which, perhaps, those interested in the history of invention would have preferred to have had a little elaborated; but, of course, it is the scientific and not the historical aspect of the subject with which Messrs. Gaster and Dow have been concerned.

The three principal forms of illumination dealt with are, of course, gas lighting, electric lighting, and lighting by oil, oil-gas, and acetylene. Each of these subjects has a chapter to itself.

The chapter on "Illumination and the Eye" is important and interesting. From this it appears that the supposed effects of the ultra-violet rays upon the human eye, to which attention was first drawn in this country by Mr. Gaster in a paper read before the Society in February, 1913, do not appear to be as important as was originally thought.

The chapter on the "Measurement of Light and Illumination" contains a great deal of novel information—novel at least to those who have not followed the subject in the pages of *The Illuminating Engineer*. The various methods employed, and the apparatus used both in outdoor and interior illumination, are very fully dealt with, and naturally enough the considerations involved apply almost equally well whatever method of illumination may be employed.

A useful, and apparently fairly complete, list of works dealing with illumination and photometry is given in an appendix.

PRACTICAL GILDING, BRONZING, LACQUERING, AND GLASS EMBOSSING. By Frederick Scott-Mitchell. London: The Trades' Papers Publishing Co. Ltd. 3s.

In 1905 Mr. F. Scott Mitchell published a book on "Practical Gilding, Bronzing, and Lacquering," which received many appreciative notices from the technical press, and was generally welcomed as a very useful manual by practical workers. The present volume is in some sense a second edition of the earlier book, but it has been revised with great care, and additional chapters have been written on Glass Embossing, Gesso and Relief Decoration, Mosaic Work, and Leading Points, while the scales of charges for all kinds of work have been brought up to date. The text gives a very clear and concise account of the various tools and processes described; the fresh illustrations which have been added to the second edition are useful and instructive; and the whole book forms a welcome addition to "The Decorator Series of Practical Handbooks."

GENERAL NOTES.

INVENTIONS BOARD.—The Secretary of the Admiralty makes the following statement:—It was announced on July 5th that Admiral of the Fleet Lord Fisher of Kilverstone had been appointed Chairman of the Inventions Board, established to assist the Admiralty in co-ordinating and encouraging scientific effort in relation to the requirements of the Naval Service. The arrangements for the organisation of the Board have now been completed. It will comprise: (*a*) a Central Committee; (*b*) a Panel of Consultants composed of scientific experts, who will advise the main committee on questions referred to them. The Central Committee will consist of: Lord Fisher of Kilverstone, G.C.B., O.M. (President); Sir J. J. Thomson, O.M., F.R.S.; Hon. Sir C. A. Parsons, K.C.B., F.R.S.; G. T. Beilby, Esq., F.R.S. The Consulting Panel will comprise the following list, which will be added to from time to time as necessary: Professor H. B. Baker, F.R.S.; Professor W. G. Bragg, F.R.S.; Professor H. C. H. Carpenter; Sir William Crookes, O.M., F.R.S.; W. Duddell, Esq., F.R.S.; Professor Percy Frankland, F.R.S., Professor Bertram Hopkinson, F.R.S.; Sir Oliver Lodge, F.R.S.; Professor W. J. Pope, F.R.S.; Sir Ernest Rutherford, F.R.S.; G. Gerald Stoney, Esq., F.R.S.; Professor the Hon. R. J. Strutt, F.R.S. The Board is accommodated temporarily in the Whitehall Rooms, Hôtel Métropole, Whitehall Place, S.W., but at an early date (which will be announced in due course) it will be transferred to permanent offices at Victory House, Cockspur Street, S.W. Communications should be addressed to the Secretary, Board of Invention and Research.

ARMY BISCUITS.—An exhibit, brought up to date, illustrating the work done in connection with an investigation undertaken to determine the origin of damage to Army biscuit by insect pests, has just been installed in the Central Hall of the Natural History Museum. Examples are shown of the old kind of Army biscuit infested by moth, etc., and condemned by the military authorities as unfit for food, and of the new biscuit now being served out to the troops. The researches, which have been carried out jointly by the War Office and the British Museum (Natural History), have ensured the protection of Army biscuit from the possibility of such attacks by insects in the future.

ECONOMY IN FOOD.—In a circular just issued to local education authorities, the Board of Education direct attention to the urgent importance of economy in food, and in particular to the desirability of restricting the consumption of meat. They point out that much can be done to educate the public as to the respective cost and nutritive value of other foodstuffs by informal instruction, adapted to the needs of housewives and others, and that lectures and demonstrations can readily be organised in connection with schools for mothers, maternity centres, mothers' meetings, and otherwise. It is hoped that, in view of the issues involved, a beginning may be made with such work even during the present summer months. Accordingly the Board have decided to make special grants in aid of instruction for housewives in economical cookery, including the following topics: (*a*) The principal kinds of nourishing foods which may be employed to supplement the use of meat and fish; (*b*) the kinds of food specially suitable for children; (*c*) the employment of economical methods in the purchase, preparation, and cooking of meat, fish, and other nourishing foods; (*d*) the use of simple cooking equipment, apparatus, and utensils, with special regard to economy in the use of fuel.

INDIAN TRADE IN 1914.—The returns of the total imports and exports of merchandise into and from India in 1914, compiled by the Department of Statistics, show that, in spite of the war having been going on for five out of the twelve months, the total imports into India were actually larger than in 1912, and only 14 per cent. less than in 1913. Exports were only slightly more affected. They are valued at £138,000,000 sterling in 1914, against £160,000,000 in 1913 and £150,000,000 in 1912. Trade with Europe was chiefly affected, that with America, Australia, and the Far East showing comparatively little variation. The main fact which appears to emerge is that the first seven months of the year were such bumper ones as almost to make up for the depression of the remaining five months.

JAPANESE NAVAL SHIPYARDS, 1914.—The most interesting vessel built in Japan in 1914 was the battleship "Fuso," of 30,600 tons displacement. This ship was launched at Kure in March, 1914, she is one of the largest and most powerful battleships afloat, carries twelve 14-in. guns in six turrets, all arranged on the centre line of the ship. It is expected that the ship will be put into commission during the latter part of this year. There are under construction three sister ships—the "Yamashiro" at Yokohama, the "Hinga" at Nagasaki, and the "Ise" at Kobe. The propelling machinery of these ships consists of Brown-Curtis turbines and Japanese Admiralty type water-tube boilers, with the exception of the "Hinga," which is fitted with Parsons turbines. The battleship "Hiyei" was completed last summer, and has been engaged in actual service; her two sister ships, the "Kirishima" and "Haruna," are undergoing speed trials. After the outbreak of the present war, a supplementary budget was passed, authorising the construction of ten destroyers of 600 tons displacement and 9,500 i.h.p. These were to be completed in six months. The hulls, machinery, and equipment of the vessels are to be constructed entirely in Japan.

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All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

COUNCIL.

At their last meeting the Council elected Sir JOHN WOLFE-BARRY, K.C.B., LL.D., F.R.S., a Vice-President of the Society, to fill the vacancy caused by the resignation of the Duke of Bedford, K.G.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Monday afternoon, the 26th inst. Present:—

Sir Steyning William Edgerley, K.C.V.O., C.I.E. (Chairman of the Committee), Sir Arundel T. Arundel, K.C.S.I., Sir Steuart Colvin Bayley, G.C.S.I., C.I.E., Sir M. M. Bhownaggree, K.C.I.E., William Coldstream, B.A., I.C.S. (retired), Sir (Frederick) William Duke, K.C.S.I., K.C.I.E., Colonel Sir Thomas Hungerford Holdich, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., Sir John Jardine, K.C.I.E., M.P., Sir Frederic S. P. Lely, K.C.I.E., C.S.I., Sir Patrick Playfair, C.I.E., Sir James Wilson, K.C.S.I., with S. Digby, C.I.E. (Secretary of the Section).

SPECIAL WAR LECTURE ON "FIELD TELEPHONES."

On Wednesday afternoon, July 28th, Mr. CHARLES R. DARLING, A.R.C.Sc.I., F.I.C., Lecturer in Physics at the City and Guilds Technical College, Finsbury, delivered a Special War Lecture on "Field Telephones."

On the motion of the Chairman, the Hon. RICHARD CLERE PARSONS, a vote of thanks was accorded to Mr. Darling for his interesting lecture.

The lecture will be published in an early issue of the *Journal*.

A SHORT HOLIDAY IN BELGIUM.

By T. B. GRIERSON, M.Inst.C.E.

In the summer of 1914 the writer spent a pleasant holiday in visiting some of the beautiful old-world cities of Belgium. This was about six weeks before the Germans began their unjustifiable attack on that country. There was at that time apparently no idea of war, nor any likelihood of it, so far as the man in the street could see.

With the intention of having a fairly long sea passage, the writer decided to travel by the Lancashire and Yorkshire Railway Company's steamers which run between Goole and Ghent *via* the Terneuzen-Ghent Ship Canal. Leaving London (King's Cross) on June 10th, 1914, he arrived *via* Doncaster at Goole.

The Goole docks, which are extensive, have recently been improved since their occupation by the Lancashire and Yorkshire Railway Company. New sheds, with up-to-date electric cranes and facilities for loading and unloading ships, have resulted in a great increase of valuable traffic, both inwards and outwards, to the railway company. This company may truly be said to be one of the best-managed and most enterprising of our English railways.

Having got safely out of the wonderful complication of inner docks and locks, barges and steam and sailing vessels going in and coming out, we found ourselves at last in the tidal sea-locks, and thence in the River Ouse. The river is so wide at this point that it looks like an arm of the sea; it is also so comparatively shallow that ships going up or down it, especially at low tide, must be carefully piloted for several miles. It is remarkable that this fine tidal river has never been made to deepen itself automatically by the construction of training walls. The [illegible] from York, reinforced by the waters of the Trent and both discharging into the Humber above the city of Hull, aided by the tidal waters, would rapidly deepen the channel. This would enable ships to go up and down at low water instead of being obliged to wait for the rise of tide, as at present.

Steaming down the river, we generally "hugged" the banks—now on one side, then on the other. Sometimes we were in mid-stream, according to the vagaries of the natural bed which the river had cut out for itself. On the left bank, on our port side, we saw the city of Hull, evidently in a state of great excitement preparing for the formal opening of the new dock by the King. This magnificent dock was opened on June 22nd, 1914, and the city was given a Lord Mayoralty by His Majesty.

Lower down on the opposite bank of the river lies Immingham, with its immense area of new docks, about which so much has been heard as to its equipment and facilities for dealing with overseas traffic *via* the Great Central Railway. If rumour is to be believed, hopes are entertained by the owners that the Admiralty may purchase these docks for use as oil-fuel stores to replace their smaller depot close by.

Looking at Immingham docks from the sea front, with their great wharves, jetties, powerful cranes and warehouses, one would think they ought to make a splendid base for the Navy, in view of the Government's recent investment in oil-fields and the Admiralty decision to use oil fuel very largely in our warships.

The weather being clear, Grimsby and Cleethorpes could be seen on our right, or starboard, side and Spurn Head on our left. Spurn Head was the last piece of England to be seen on our journey to Holland and Belgium. We then steamed on at a speed of about eleven knots an hour, until we arrived at the old Dutch town of West-Kapelle, whose church tower is used as a lighthouse. Here, owing to a dense fog, we were obliged to anchor for some hours; here also the Government pilot came on board to take us along the Dutch coast to Flushing.

Although the weather was fine and warm and the sun shining over our heads, there was nothing to be seen inside our small ring of fog-encircled bluish-green water except jellyfish and the many porpoises which looked soft and curved, happy and handsome, as they tumbled about in the sea. When the fog lifted we saw a large number of steamers which had also been at anchor. Many of these vessels were making for the same general destination as ourselves, namely, the River Scheldt.

As we passed along the coast of Walcheren (Holland) we could see the great number of groins running out into the sea for the protection of the land. The coast of Holland lies very low, although many of its sand dunes, our pilot told us, rise to a height of thirty metres, or nearly a hundred feet. The entire coast is protected by groins, some of which are of concrete but most are of timber. These groins are cleverly arranged as to height and angle with the coast, so as to get the greatest protection at the least cost. Dutch engineers are great experts in land reclamation and coast protection. Those who have had much experience of that class of engineering can appreciate their work.

The rampart walls and fortifications for the protection of the coast towns are generally of concrete with a facing of brickwork towards the sea. The groins, however, are the main protection of the land which has been so hardly won from the sea. They prevent it from "reverting to type" and going back to become sand again in the bosom of its enemy.

The towns along the Dutch coast are very picturesque. The windmills and the quaint old cottages with their bright red tiles give a warm and homelike appearance. The contrast between the Yorkshire coast at Goole, with its woods and fine trees, and the coast of Holland, which is practically bare, is very marked.

Arrived off the town of Flushing, we could see the old brickfaced fortifications, standing very high above the sea-level, their bases and foundations protected with groins on the beach. Flushing was once a strongly-fortified town but is now a pleasure and bathing resort. We could see the Grand Hotel, a fine building with a tower at each end. There were also many "pensions" and a large number of bathing-boxes along the coast, the splendid sands being crowded with bathers. It looked incongruous to see in places so ancient and old fashioned great up-to-date electric travelling cranes and gantries, denoting large engineering works and shipbuilding yards.

We dropped our first pilot and took up a second here, to conduct us through the intricacies of the West Scheldt to Terneuzen.

The deep-water channels off the coast of Holland and in the estuary of the Scheldt are carefully defined by the most recent types of beacon-buoys. Some are of the bell-buoy type; others are whistle buoys. The latter are filled with compressed air, and when the buoy is rocked by the waves in rough weather the air is automatically allowed to escape against a sharp edge, thus causing a whistling sound which can be heard at great distances. There are also "lightships" anchored over or close to various shallow spots. These ships are of the usual type, with three masts. They act as beacons by day and, when the great lanterns are lit and hoisted up to the masthead, as danger signals at night. These precautions are very necessary for the protection of the immense number of steam and sailing ships which pass to and fro between Great Britain and the Continent.

A not unusual sight was that of a steam tug with two or three large barges in tow carrying coal and general merchandise between England and Belgium. Some of these barges towed between England and Ghent carry as much as 3,000 tons of actual cargo.

In consequence of the inferior quality of the coal found in Holland and Belgium, English coal, coke and slack are in great demand and form a large proportion of the exports from this country. There is also an immense traffic in general merchandise. For instance, the steamship "Wharfe," in which the writer travelled, had coal in her lowest hold, and carried, amongst other things, several portable engines, many tons of water-tube boilers, as well as reaping, mowing, binding and threshing machines.

That the imports or back-loads of the vessels from the Continent also pay well is proved by

the fact that the Lancashire and Yorkshire Railway Company alone have as many as twenty-four large steamers, aggregating over 21,000 tons, continually plying backwards and forwards between Goole and Holland, Belgium and Germany. At all events, they had them before the war, the traffic being mainly in merchandise.

There are extensive beds of lignite and peat in both Holland and Belgium, and there can be little doubt that the day is not far distant when both lignite and peat will be utilised. Valuable oils and alcohol have already been obtained in small quantities from these substances. The alcohol can be used in spirit engines and for general power working. Also, a wonderful fuel has recently been produced from peat. It burns with an intense heat, without smoke or flame, and practically without dust or ashes. The writer has seen experiments with this fuel, a sample of which is in his possession, and he mentions the fact to show that the subject is receiving from scientific men the attention which it deserves, especially as to the cost of its production.

Patent fuel is a large industry in both Holland and Belgium. The fuel is sold in the form of briquettes, composed of coal dust, tar, and lime, and makes a hot fire without much dust or ashes. This kind of fuel is also at present in use in the colliery districts of Wales, being found to be suitable for small tubular steam boilers, as it does not injure the tubes or choke them with ashes. Patent fuel is cheap in Wales, being sold at 15s. per ton, whereas suitable coal in the same district is 25s. per ton.

We found ourselves at about half-past one o'clock on a lovely summer afternoon off the famous old Dutch town of Terneuzen. Here we entered the sea locks of the great ship canal which was to carry us in four and a half hours to the city of Ghent in Belgium. Entering the locks we were soon raised to the level of the water in the canal, and proceeded on our journey in smooth water.

There are three sea-locks at Terneuzen, the largest and newest being 460 ft. long and 59 ft. wide. Ships up to 7,000 tons from South America, carrying bales of cotton to Ghent, pass through it constantly.

The sill at the lock gates at the sea end is 3 ft. lower than the inner sill, enabling vessels drawing 16 ft. of water to enter the lock at all times of the tide. The time of high water at Terneuzen is the same as that at London Bridge —a useful fact for mariners. All the lock gates, sluices and also the opening bridges over the canal are worked by electric power in the most up-to-date manner.

The date on the granite pierhead of the locks at Terneuzen is 1904, cut in large figures in the masonry. The original lock entrance, still in use, is much smaller and was built about ninety years ago. The canal was much narrower and not so deep then as it is now. In the year 1900 the traffic had increased so much and vessels of so much larger tonnage desired to use the waterway, that the two Governments of Holland and Belgium jointly decided to enlarge the canal. This was a huge work, which occupied eleven years, and the canal as it now stands was completed in 1911.

It would be interesting to know the cost of enlarging the canal, which must have been great. Owing, however, to its construction and enlargement being undertaken as a national work, the cost appears to have been a secondary consideration, the great point in view being to open up the city of Ghent, the capital of East Flanders, to the commerce of the world. This was done. In addition to large local and foreign trade on the canal, an immense business in bales of cotton was done through Ghent as a distributing centre with the United States, Texas, South America, Africa and the Congo, as well as with European countries, including Russia and the industrial districts of the Baltic.

In 1860 the number of vessels which used the canal was 357, having an average cargo of 138 tons per ship, the total for the year being 49,218 tons. With every increase of the facilities since that time up to the beginning of the war, there has been a steady increase in the tonnage. In the year 1913 the number of ships which used the canal was 1,398, with an average per ship of 759 tons, the total for that year being 1,061,425 tons. These figures show that the foresight, enterprise and large expenditure of the two countries have been fully justified.

But the canal was not only a commercial success, it was also a great engineering feat. It is located in the midst of low lying flat land, the banks being a few feet above water level. The country for miles around is not higher generally than the level of the banks, and in many places it is lower than the level of the water.

These low-lying lands were formerly subject to floods, which caused great injury and heavy losses to agriculturists and others. The country being liable to violent thunderstorms, the rivers Lys and Scheldt at such times become suddenly swollen and carry down immense quantities of water. In locating the canal this fact was borne in mind: the canal water-level was arranged to be the same as that of the normal water-level of these rivers where it joins them, the result being that the canal is fed automatically with water from the rivers without any storage reservoirs or pumping plant and pumping being required. In this way the water lost by evaporation, leakages, local water supplies, and the filling and emptying of the sea-locks when the vessels pass up and down, is replaced.

When the rivers are in flood the canal acts as a great relief conduit, conveying all surplus water to the sea through the locks at Terneuzen. This is a great advantage, as much land which was formerly of little use has now been brought into cultivation.

The canal, having the same water-level throughout its entire length, has also the advantage of not requiring intermediate locks. This not only saves labour and waste of water in times of drought, but also reduces to a minimum the delays to steamers passing up and down.

There are, however, two intermediate sets of locks in the length of the canal. These are at Sluyskill and Sas-van-Ghent, and are only intended for use in case of accidents or when floods bring down polluted water which might injure the canal and its local industries. In such cases the lock gates can be closed at once.

The prevention of floods enormously increased the value of land and property in the neighbourhood of the canal, and consequently the revenues derived from rents and taxes. In point of fact, the whole district through which the canal passes instead of being a wilderness was a "watered garden" producing large quantities of vegetables, bulbs and flowers. The land was also so well drained and hard that factories of various sorts sprang up in the vicinity of both banks of the canal. Amongst these are works for the manufacture of motor spirit, cement, sulphuric acid, manure, tar, railway sleepers, patent fuel, etc. The names of well-known British firms were to be seen amongst others as owners of wharves and works, busy and prosperous.

In the proposed improvements of British and Irish canals, in order to make them suitable for steamships, this canal might well be an excellent example to follow. A ship canal like the Terneuzen Ghent Canal, if made across Ireland through unproductive country such as that between Dublin and Galway, would drain large areas of peat bog and other waste land. Such a canal would give permanent employment to thousands of the labouring classes by the exploitation of the splendid limestones, marbles, brick clays, gypsum beds, and iron and coal mines with which the country is endowed. It would also shorten the voyage between London and Canada by about 500 miles, a saving in time of one day between Great Britain and North America. This is a subject which may perhaps receive the attention of the new Irish Government. It may not, therefore, be out of place to state here that there is in Ireland about a million and a quarter horse-power of water available for industrial purposes running to waste.

The banks of the canal are mostly sloped back, about one and a half to one, instead of being vertical like our British canals. The slopes are paved with flat stones or several courses of brickwork in cement, laid on a bed of concrete. These slopes are less expensive than vertical retaining walls, and are much better than vertical banks of clay, as they are not injured by the waves made by passing steamers, motor-boats and motor-barges, as clay banks are found to be. On the other hand, the slopes make the canal wider, and involve the purchase of more land for roads and towing-paths than is required with vertical banks or retaining walls.

Some of the older docks in Belgium have slopes instead of vertical walls, causing loss of valuable storage room on the dock roadways and wharves. All the new docks in Belgium are now, however, being built with vertical masonry walls, thus enabling ships to lie close to the quays and to discharge their cargoes more conveniently and rapidly. The construction of the large masonry piers and walls of the sea locks at Terneuzen was a work of some difficulty and presents one or two interesting features. For instance, the lock walls have the appearance of Roman tesselated pavement made of five-sided tiles.

It appears that the pier heads are of granite ashlar backed with concrete; the lock walls are built of concrete reinforced with blocks of 6 in. columnar basalt, pentagonal in cross-section and about 4 ft. long. The blocks were laid close together built into the concrete, their outer ends being set flush with the face of the wall and the top finished with granite coping. This forms an extremely hard surface for resisting the rubbing and bumping of the ships, and has a very pleasing appearance. The basalt blocks were imported from France and the cut stone granite from Germany. All the lock walls are built in the same way. In a few places where special wharves are now required retaining walls are being built of reinforced concrete, locally called *béton armé*.

The distance from Terneuzen to Ghent is about twenty and a half English miles, of which the canal proper is eighteen miles. Of the canal, eight and a half miles are in Holland and nine and a half in Belgium. In the Dutch portion the width of the canal is 220 ft., the width at the bottom being 78 ft. In the Belgian portion the width at water level is 318 ft., the width at the bottom being 154 ft. The depth of water throughout the eighteen miles of canal is 28 ft. 6 in.

The portion of the canal in Holland not being so wide as that in Belgium, crossing basins have been built at Sluyskil and Sas van Ghent, in addition to that at Terneuzen. With the excellent telegraphic and telephonic installations on the canal, the traffic can be worked on the absolute block-system if accidents, emergencies or abnormal increase of traffic should make it desirable to do so.

The speed of steamers and motor-boats traversing the canal appears to be about six miles per hour. The speed of the steamship "Wharfe," including stops, between Terneuzen and Ghent, averaged five miles per hour. The speed of the old canal boats, horse-drawn, on British canals is about two miles an hour. There are eleven opening bridges over the canal, two of which deserve notice. One carries a public road and the other a railway. The two main girders of each bridge are of steel, latticed, in one span of 85 ft.

Here is a description of the railway bridge at Selzaete; but both bridges are practically alike.

Each main girder has its lower flange at the west end, continued over the abutment, but, instead of being continued horizontally in a straight line, it is curved upwards in the form of a semicircle to about the height of the top flange, the end of each girder thus being semicircular. Near the top of the semicircular curve a powerful pin with a tension bar attached to it is fixed. To open or raise the bridge, the tension-bar is pulled horizontally in the direction of the abutment by electric power operated in a signal-cabin at the end of the bridge. This tilts up the entire bridge on its curved end, thus allowing a vessel to pass through. The operation of opening or closing the bridge is so rapid that it is only a matter of seconds. The signals on both the railway and the canal are under the control of the one signalman in the signal-cabin at the bridge, who raises and lowers the latter as required.

The voyage along the canal from Terneuzen to Ghent was extremely interesting. We left Terneuzen at two o'clock in the afternoon of June 12th in extremely hot weather, with everything in our favour for a splendid view of the country, the people, and the various industrial works.

The first town we came to was Sluyskil, where there is a passing basin and a large swing-bridge over four spans. Here on the east side the canal widens out into two branches. There is also a short piece of a third branch, partly made.

At this place we first saw the working-men in their blue jackets and sabots. The workmen's cottages, of about three rooms, along the banks of the canal looked picturesque with their red-tiled roofs and shuttered windows painted green and white. Everything about them, including the wooden palings, the footpaths, even the shrubs and flowers, looked painfully clean and neat.

The first reach of the canal for about four miles is quite straight and presents a noble appearance. This reach runs from north to south, the north end being at Terneuzen.

There are good cart roads along the canal banks, that on the west bank being paved with 6-in. square stone blocks.

The roads are lit throughout the entire length of the canal with incandescent lamps of twenty-five candle power, placed 164 yards apart on the straight portions and 82 yards apart on the curves.

There is telephonic and telegraphic communication with all bridges, locks and signal-cabins. Electric cables convey current for operating the locks and bridges and for industrial purposes where required. There are electric cranes and transporters for dealing with traffic at the various wharves along the canal.

The rule of the road for vessels is to keep to the left. Imagine, therefore, the horror of the writer, when standing on the bridge with the captain, on seeing a tug with four barges coming towards us on the same side as ourselves! The captain merely observed that some of the masters of vessels were not very particular, and, as the canal was wide enough, he simply steered his 1,000 tons steamer to the right until they had safely passed.

Great numbers of birds are to be seen along the canal, especially cranes, probably because of the marshes in the vicinity.

On arriving opposite the town of Sas-van-Ghent we were at the boundary between Holland and Belgium. Here we had to stop and make fast to the Custom House jetty while the captain and the chief officer went ashore to make affidavits as to the numbers and identification of the passengers and crew. This is done at the Custom House, a long one-storied red brick building on the east bank of the canal.

This building is placed at the centre of a carefully-defined boundary line, which is supposed to cross the canal diagonally from a large cast iron pillar on the east bank to a similar pillar on the west bank. These pillars are about half a mile apart, one being in Holland and the other in Belgium.

"Protection" is strictly enforced between the two countries, and the questions to be answered by officers of trading vessels are very searching. For instance, one of the most important questions was as to whether any person on board, including the crew, the officers and the passengers, had bought any new clothes during the voyage, and if so, what became of the old clothes? This seemingly silly question was to find out if any infectious disease was on board, and to prevent it from being brought into the country.

In addition to full particulars of all wine, spirits, beer, tobacco and general contraband on board, the quantity of tobacco in each smoker's pouch had to be stated in writing.

We arrived at the Congo Wharf, Ghent, at ten minutes past six o'clock in the evening of June 12th, after a most enjoyable passage.

Ghent.

Immediately the ship had been made fast to the wharf she was boarded by a smart stevedore

with a large gang of ship labourers, and the unloading of the cargo began.

It was positively refreshing to see the energetic way in which the Belgians went to work—no fuss, but methodically, and in less than half an hour they had all the deck load removed to the quays. All general merchandise was unloaded at the Congo Wharf, and the ship was then brought to the opposite side of the great docks, where the coal cargo was removed by electric transporters, and the ship made ready by noon next day to receive her return cargo for Goole.

The dock accommodation at Ghent is very extensive and up to date, but the constantly increasing traffic has made it necessary to build further extensions. New docks and quays of great extent with large stores and sheds have just been completed. These works were partly built by the Belgian Government and partly by the great shipping companies of Belgium, the Agence Maritime of Ghent and others.

The man of "push and go" of this business is M. Edmond Minne, the general manager of the Agence Maritime, to whose energy and ability the city of Ghent owes much.

M. Minne, who is also the Consul for Cuba, states that two million bales of cotton per annum are imported into Ghent by the companies with which he is connected. This cotton is exported from Ghent to various parts of Europe, including Russia and the spinning centres of the Baltic.

Cotton is also largely used in the city of Ghent, where there are a million and a half cotton and flax spindles at work, in addition to fifty thousand looms, the whole employing about fifty thousand hands.

Ghent, with its population of two hundred and twenty thousand, is rapidly becoming a great manufacturing and mechanical engineering centre. Also, its position at the confluence of the two rivers, Scheldt and Lys, has made it truly a paradise of flowers. Many of the beautiful plants in our gardens and conservatories come from there, such as bay trees, laurels, azaleas, aspidistras, orange trees, araucarias and palms, large quantities of which are imported annually into Great Britain.

There is an excellent system of electric tramways throughout the city and suburbs, with frequent service and cheap fares. The road waggons, drawn by horses for conveying heavy loads, have generally only three wheels one in front and two trailers.

The town of Ghent is so intersected with canals that it forms practically thirteen islands, with fifty-eight bridges. Perhaps this, with the consequent want of space, accounts for the great bulk of the streets being so narrow. The pavements and footpaths are mostly paved with pebble stones, which makes walking uncomfortable. The main thoroughfares are, however, well and properly paved with smooth surfaces.

The railway stations are imposing buildings, and well designed for their purpose. The permanent way consists of flange-rails laid on small wrought-iron plate-chairs bolted to half-round sleepers. The ballast used was mostly ashes, but in some places it was of limestone gravel.

The great main lines were in good working order when the writer saw them. The coaches were first, second, and third class; few people travelled first, the coaches of which were excellent. The second and third classes were not nearly so good as English coaches; they were not cushioned except on some of the main lines. The branch lines were by no means well maintained, either in permanent way or rolling stock, with the exception of the engines, all of which on all lines were good. The railway fares were too high, the first class greatly so; and although in all cases passengers could obtain a fairly cheap season ticket by paying considerable sums, a poor man could not do this. In fact, the whole railway system required revision apparently, but could no doubt be made to pay well with cheaper fares.

Railway time in Belgium begins at twelve o'clock midnight, all the time-tables being worked out for twenty-four hours. A train which in England would start, say, at 9.45 p.m., would in Belgium be tabled to start at 21 hours 45 minutes. In restaurants, hotels and private houses Greenwich time is used.

Ghent being an industrial flax and cotton spinning centre, it was interesting to compare the dresses of the women and girls going to and from their work with those in Lancashire and the north of Ireland. In the latter two districts there is not much trouble taken to dress neatly during working hours, and any person who has stayed in Lancashire hotels knows the noise the clogs of the workers make on the street pavements at five o'clock in the morning. Ghent has none of this, so far as the writer could see.

There was the inevitable shawl over the head in many cases, although it was summer weather; but the greater number of the girls were neatly dressed with smart French boots or shoes, neatly trimmed hats, and up-to-date blouses and jackets.

COURTRAI.

Courtrai, in West Flanders, stands on the River Lys, and has a population of about thirty-five thousand. Its principal business is the growing and weaving of flax, the soil, water and climate being singularly suitable for the cultivation of the flax plant. So great is the quantity of flax produced that, in addition to supplying its own wants, it is able to supply other places, including the North of Ireland (the city of Belfast, in particular), with a large proportion of what is used there. The flax grown in the Courtrai district is reputed to be of the highest quality known in the trade. This is supposed to be due to the waters of the River Lys, which, rising in the north of France,

carry down with them to the swampy lands surrounding Courtrai various effluents from the dyeing and other chemical works along its banks. There is a colony of Ulstermen at Courtrai, numbering about three hundred, whose business it is to purchase and supervise the growth and steeping of the flax before it is despatched to the North of Ireland markets.

The Belfast buyers call the River Lys "The Golden River," because the flax grown on its banks commands a higher price than any other known.

The writer saw the previous year's growth undergoing the process of "retting," or steeping, in crates on the banks of the Lys. The land was very flat and the river wide and shallow, except in the centre. The crates were held in their places by stakes driven into the ground, so that the water could permeate the flax bundles. Gangways were made of wooden planks from the top of the banks, leading down towards the centre of the river at intervals between the crates. These gangways were for the purpose of inspecting the flax, so as to decide the length of time required for the process of steeping. When the flax is sufficiently steeped it is taken out and piled in stooks to dry. In many cases it is kept in store during the winter and put into the river a second time the following season, after which it is taken out and dried on cone-shaped supports. When the flax is quite dry it is stored for a time and subsequently sent to the scutching mills.

Courtrai flax is noted for its great tensile strength, fineness and colour. The writer has a sample of the flax stalk, in its raw state, which is as difficult to break as a piece of twine. This is at first surprising, seeing that the stalk is only as thick as an ordinary hay-stalk; but inside the husk there are twenty to thirty white threads like silver grey hairs, fine and strong. These are the flax threads from which the linen is made.

The crates of flax when undergoing the process of steeping extend for miles on each bank of the river, which is of great width. The writer was told that steeping the flax in the waters of the Lys made it soft and flexible without injuring its texture or reducing its tensile strength. Several factories were in full work, employing large numbers of hands in preparing the flax for market, notably that of "The Linen-thread Company of Courtrai."

Lace-making is also carried on in the district, some six thousand women being employed. Large quantities of lace were to be seen in the fields "bleaching" along with the linen. Linen, woollen and cotton weaving mills, tobacco factories, sugar, soap and paper-making works employ thousands of hands.

The writer is much indebted to M. Deschoemaeker, of Courtrai, whom he had the good fortune to meet there, for a great deal of the above information, and for his kindly advice and courtesy to a stranger in a strange land.

It is remarkable that Ulster should now largely depend upon a town in Flanders for the flax used in one of her principal industries considering the large quantities she grows herself. Yet this is so, for practically all the large flax mills in the North of Ireland, including the York Street Spinning Company, Belfast, which employs thousands of hands, have extensive stores and offices at Courtrai, and large continuous business is done between the two places. It must not be forgotten that there is a sort of affinity between the two peoples. The Flemish people who settled in Ulster in the sixteenth and seventeenth centuries were the ancestors, to some extent at all events, of those who are now the workers in Belfast. Although Flemish weavers were introduced into England in the reign of Henry III at the beginning of the thirteenth century they appear to have largely employed their talents in the North Country; and even now Leeds in England, Dundee in Scotland, and Belfast in Ireland may be said to be the principal spinning centres in Great Britain.

Wherever the Flemings went they seem to have brought good luck. Their careful, thrifty habits, steady perseverance in their work, the ingenuity and art displayed in its execution—all have been of great value to Great Britain and Ireland. Who has not admired the beautiful tapestries of the sixteenth and seventeenth centuries depicting historic battle-scenes, many of them the work of Flemish weavers? Surely it is not straining the fact to say that Britain in helping Belgium now in her hour of need is doing nothing more than making some return for the prosperity which the Flemish people have brought to this country wherever they have settled.

There are many places of historic interest in Courtrai; but the great Battle of the Spurs, which took place on July 11th, 1302, overshadows them all. In this battle twenty thousand Flemish, mostly weavers of Ghent and Bruges, defeated and put to flight seven thousand knights and noblemen of France and forty thousand infantry. After the battle some hundreds of gilt spurs were found on the field and kept as trophies, to be handed down to posterity.

The Flemish were under the command of Guy de Namur, to whom a golden (gilt) statue has been erected on the Boulevard de Groeninghe. The gardens along the boulevard are beautiful. Some of the flower-beds surrounding the statue are planted to represent his coat-of-arms, the different colours of the flowers being produced in accordance with heraldic requirements. The gratitude of the people still impels them thus to keep their great leader's memory green.

The working classes are very proud of the fact

that they were able to give so good a thrashing to the very men and their leader who had previously beaten and oppressed them. Let us hope that history will repeat itself in the near future with the present ruthless invaders of Belgium!

There are, as usual in Belgian towns, some fine old buildings in Courtrai, including the town hall, with splendid frescoes in the alderman's room representing events in the history of Flanders. A great picture by De Keyser, in the museum, represents the Battle of the Spurs.

There is a street bridge with a very old round tower at each end. These towers were probably for defence in ancient times, but are now used as a museum. A golden crucifix seen from the street is let into a "slit" in one of the towers.

Amongst the statues in the town there is one erected to Jean Palfin, who invented the forceps.

A racecourse in the suburbs appears to be well patronised by the working-classes.

The streets of the town are generally paved with six-inch square stone blocks, which caused much jolting when driving over them in the one-horse old-fashioned victorias in use.

The post-office is a fine stone building with a large square tower with louvres. The whole of the four sides above the roof are covered in regular rows with the insulators of telephones and telegraph wires, in different colours, which gives the whole a peculiar appearance. The wires are evidently conveyed to the instruments through the louvres.

The railway station is mostly a long one-storied building, with several lines of rails and platforms. Courtrai is an important junction for north, south, east and west trains so important that the aviators of the Allies have recently dropped bombs upon it which caused great injury, especially to the railway lines. As in other towns of Belgium, dogs are used for hauling light carts, but horses are used for heavy work.

The people appeared to be of the well-to-do class—well dressed and well fed. The hotels are properly managed, clean, and the food and drinks good.

Antwerp.

The city of Antwerp is, next to Brussels, the largest town in Belgium. It is situated on the River Scheldt, about fifty-three miles from the sea, and has a population of about three hundred and twenty thousand. The fortifications, forts and walls with gates, which practically surround the city, were found to be too near thereto to protect it against modern artillery. Some years ago the late King Leopold began to build new and more distant forts and defensive works, which were in progress when the present war began.

The city is well built, with broad streets planted with trees along the wide, smoothly paved footpaths. The streets are lit with powerful electric lights; and electric tramways, with frequent services and cheap fares, run through the city and suburbs in every direction.

The river opposite the town is about four hundred yards wide and very deep. The quays are many miles in length, and steamers can come up close to the town. Excursion steamers ply across and both up and down the river to places of interest at cheap fares. The view from the landing-stage, near the offices of the Lancashire and Yorkshire Railway Company, on the Quay Jordaens, is interesting, showing the great width and length of the river, and the steamers constantly arriving and departing for all parts. There are no less than eighty-nine lines of steamers, including ocean-going vessels, which make Antwerp one of their most important ports of call for the Continent of Europe.

The railways have four main-line passenger stations in various parts of the city. The central station, at the top of the Avenue de Keyser, is a splendidly built structure which cost about £1,500,000 sterling.

The beautiful bronze entrance gates of great size, are said by the newspapers to have been removed recently by the German invaders to melt down for making heavy guns. This piece of vandalism was only to be expected, seeing what they have done in other towns in Belgium.

The public buildings of Antwerp are of the highest historic and architectural value. The cathedral spire, a beautiful work of art, is one of the first objects to be seen by vessels coming up the river. It is about 470 ft. high, and the building covers an area of 70,000 sq. ft. This is more than that covered by Cologne Cathedral perhaps for this reason the Germans may destroy it! The foundations were laid in 1352, and the structure occupied nearly two hundred years in building.

Antwerp is, of course, a great centre of art. The magnificent pictures in the cathedral and many other public places, as well as the buildings themselves, show this; and Rubens, Van Dyck and other great artists were born there.

As an industrial centre the city has a great reputation: the diamond-cutting trade alone has made it known all the world over. The industries include anything "from a needle to an anchor." In proof of this, steel rails, girders, rolled joists, and every kind of heavy iron-work are made there. The following incident will speak for itself. A Belgian gentleman gave the writer a small object, in a piece of white paper, which was too small to distinguish with the unaided eye. On putting it under a powerful magnifying glass it proved to be a very small screw with a cylindrical head and a slot in the top, the thread being complete and all beautifully finished in bright steel. The gentleman was the owner of a works in Antwerp which made thousands of similar screws for watch-making.

The Zoological Gardens well repay a visit.

Instead of being placed in the suburbs, like most of the "Zoos" which the writer has visited, they are situated in the town at the head of the Avenue de Keyser, adjoining the central railway station. They cover a very large area, but are so well arranged that there is no loss of space, the land being almost wholly covered with fine buildings; but the walks and passages are all of ample width. The collections of wild and domestic animals, reptiles and birds have the reputation of being the finest in Europe.

The aquarium was a delightful place, cool and interesting, as the weather was very hot, the sea-horse being "stabled" in one of the tanks. The buildings for housing the animals were architecturally superior to similar buildings in other places. The concert-hall, restaurants and places of entertainment seemed to be arranged to tempt visitors to remain a whole day in the gardens, and this they appeared to do. Many fine monuments and splendid pictures were also to be seen in the entrance hall.

For moving about the city there are plenty of taxicabs. The electric tramways, however, are more popular, as the penny fare pays for a long journey. The tramways are continued along the quays and docks, past the berths of many lines of steamers well known in England. Indeed, the quays remind one of the London docks and the Thames.

When returning to England the writer left Antwerp by one of the Lancashire and Yorkshire Company's fine steamers for Goole. Going down the Scheldt, a splendid view of that river and the quays and docks along it was to be had. One peculiarity was that some of the shed roofs on the quays were made flat for promenades, and had parapets all round. These roofs were converted into public gardens, with shrubs and flowers planted in boxes and semi-barrels, with seats for the public, who could be seen enjoying the fine views of the river and shipping, and obtaining a breath of fresh air. The roofs of the old forts not now in active service, were also utilised for the same purpose.

There is an excellent service of trains between Antwerp and Brussels, the journey of thirty-one and a half miles being run in about half an hour.

The writer's thanks are due, and are hereby tendered, to the officers of the Lancashire and Yorkshire Railway Company for their courtesy and kindness both in England and Belgium; and particularly to his old friend Mr. John Dowling, the London and Continental Traffic Superintendent, who, he regrets to say, has recently "passed over to the majority."

PAPER-PULP MANUFACTURE IN MYSORE.

According to a report recently presented to the Mysore Economic Conference, investigations into the practicability of the manufacture of paper pulp in the State are being proceeded with in several directions. The forests have been explored for suitable raw material by special officers deputed for the purpose, and a qualified technical expert, Mr. Raitt, has been engaged to conduct tests on samples of grasses and bamboos locally available, with a view to arrive at an estimate of the working costs under factory conditions. An agreement has been concluded with one of the factories in India to get paper manufactured out of twenty tons of crushed bamboos sent from Mysore. The resources in Mysore, both in grasses and bamboos, appear to be ample for the manufacture of pulp on a commercial scale. The Mysore district is specially rich in large grass areas, and eight forests, of an aggregate extent of 456 square miles, have been explored during the year. There are at present two cotton-mills in Bangalore, and the question of starting another mill has been under the consideration of the committee for the past two years. It was at first contemplated to establish the mill at Davangere or Harihar, but subsequent inquiries have proved that Bangalore was the most suitable place The electric energy available at Bangalore would offer a convenient source of power, and facilities for obtaining labour would be greater there than elsewhere. In regard to the question whether there is room for an additional cotton-mill in the State, the report prepared by the Director of Industries and Commerce offers a conclusive answer. It has accordingly been decided that a mill with 2,500 spindles and 500 looms, with an estimated annual outturn of 32 lakhs of lbs. of yarn and 18 lakhs of lbs. of cotton cloth, may be established with reasonable prospects of success. The capital required to run the mill is about 16 lakhs of rupees

THE PRODUCTS OF COAL DISTILLATION.

In a paper recently read before a conference at Cardiff, Mr. W. J. A. Butterfield discussed several important aspects of this question, and gave some valuable statistical information.

The output of coal in the United Kingdom in 1913 was 287,430,473 tons; in Germany it was 188,485,000 tons, but in addition to this 86,093,000 tons of brown coal or lignite were raised. The United Kingdom retained for home consumption 189,092,369 tons; Germany retained about 155,503,000 tons, and 93,455,000 tons of brown coal, part of which was imported. These figures show a mean consumption of coal of 4·108 tons per head in this country, as against 3·68 tons of coal and lignite in Germany, and as the coal consumption may be taken as an index of the industrial activity of a country, these figures are satisfactory.

With regard to the manufacture of gas and coke, it is estimated that in 1913, 37,483,944 tons of coal were used in this way in the United Kingdom, something over 16,000,000 tons being carbonised in gasworks. In Germany the total quantity carbonised was 62,613,000 tons, only about 9,000,000

tons being used in gasworks. While 42·7 per cent. of the coal carbonised in this country is treated in gasworks for the production of coal gas, in Germany the corresponding figure is only 14·4 per cent., the greater quantity being treated for the production of coke.

Owing to this larger proportion being carbonised in ovens in Germany, the quantity of some crude products which are of primary importance in chemical industries, such as benzol, is very much greater in Germany, considering the total amount of coal carbonised, than in the United Kingdom.

The recovery of benzol has now become a matter of national importance, since toluene, which forms from 10 to 25 per cent. of the benzol, is in great demand for the manufacture of trinitrotoluene. In recovery-oven practice the gas is stripped of all the benzol content, but in gas-making only the toluene content and the benzol is removed permanently from the gas.

Benzine, toluene, and xylene, which are obtained from the heavier fractions of benzol and the lighter fractions of naphtha, are the raw materials from which many nitro-compounds are produced for the manufacture of explosives, and for the preparation of bases, such as aniline, toluidine, xylidene, etc., which are the starting-points for the manufacture of large classes of dye-stuffs and drugs. Congo red, indigo, many aniline dye derivatives, fuchsine, and eosine, are among the most important of the derivatives of the benzine hydrocarbons. The heavier oils, too, are important. Phenols yield valuable disinfectants, and phenol itself is the raw material for the manufacture of salicylic acid, many dye-stuffs, and the important explosive picric acid (lyddite).

COMMERCIAL SITUATION IN JAPAN IN 1914.

Naturally the war has affected Japanese trade very seriously, and from the figures given below, writes H.M. Commercial Attaché at Yokohama, it will be seen that there has been a great curtailment in the volume of business transacted; yet a large part of this reduction must be ascribed to causes unconnected with the war, and it will probably be found that, although Japan is actually one of the belligerents, the effects produced on her trade have on the whole been less than has been the case with many neutral countries.

The value of the import and export trade of Japan, including Formosa and Korea, for the years 1912 to 1914 is shown in the following table:—

Imports.

As regards imports there is no question that even without the war there would have been a very serious decrease. Up to the end of July that decrease was no less than £3,363,300, and it would have grown proportionately greater as the year advanced. This was the natural result of the Government's policy of economy and retrenchment, which meant the curtailment or postponement of many public works. There had also been a general feeling of depression which was reflected in the placing of fewer orders for goods from abroad, while the fact that the rice and sugar crops in Japan and Formosa respectively had been good accounts for a big reduction in the imports of these two staples. It would hardly be fair, therefore, to ascribe to the war the whole or even the greater part of the falling-off in the import trade. It is true that the difficulties of exchange, high marine insurance rates, and the prohibition of export of many articles from Europe seemed to paralyse trade for a while, but as confidence is gradually returning, inquiries are beginning to dribble in, and although the embargo on many exports is naturally making trade with the United Kingdom impossible in such goods, there is a feeling that the import trade will soon begin to show signs of recovery. Stocks, generally speaking, are getting low, and dealers who have been pursuing a hand-to-mouth policy will soon have to make up their minds and place their orders regardless of the fact that prices have gone up.

Exports.

As regards exports the position is very different. In this case the direct effect of the war is undoubted. Raw silk and silk products are Japan's most important exports. In ordinary years they account for nearly 40 per cent. of the total shipments abroad, and as silk is a luxury, the demand for which must necessarily be greatly curtailed in times of war, and as, moreover, next to America, France is the greatest buyer of Japan silks, the declaration of hostilities produced a crushing effect on the silk market. Prices of raw silk, which had been round about 1,000 yen per picul (about £102 per 133⅓ lb.) in July, dropped till they fell below 700 yen per picul (about £71 10s. per 133⅓ lb.), but although America continued to make large purchases at these reduced prices, the total export shows a large falling-off both in quantity and value. Up to the end of July there had been an increase in silk exports over the preceding year of about £1,380,000. By December this had been converted into a loss of over £2,760,000.

Year.	Imports.	Exports.	Total.	Excess of Imports over Exports.
	£	£	£	£
1912	67,850,587	55,897,093	123,747,680	11,953,494
1913	79,482,751	66,451,893	145,934,644	13,030,858
1914	64,612,000	62,259,100	126,871,100	2,352,900

As regards other exports it cannot be said that they were very seriously affected. For the first few weeks after the opening of hostilities there was little doing, but recently a large development has taken place. This is not apparent in the 1914 returns as the orders have only recently been booked, but there is little doubt that, with the exception of silk, Japan's export trade will benefit on account of the war. The chief obstacle at present is the lack of shipping facilities, but there have already been large shipments—with more to follow if space is available—of rice, green peas, oats, and barley to Europe, wheat and bran to Australia, and Manchurian maize from Kobé to the Pacific coast. Nearly all this business is exceptional and can only be ascribed to the war. Again, large orders are being booked for toys, cheap glassware, acetic acid, sulphuric acid, etc., all of them lines in which Japan has a chance of pushing her goods while other competitors are out of the field.

TRADING DIFFICULTIES.

Certain trades have suffered from inability to get the necessary chemicals, such, for instance, as the match industry, which had to curtail production on account of shortage of supplies of chlorate of potash. Others, like the cotton-spinners and the copper-mine owners, were badly hit by a tremendous drop in prices. The farmers, with rice quotations falling day by day, became increasingly despondent and could not afford to buy fertilisers.

The troubles of the cotton, copper, match, and other groups were gradually surmounted. The semi-Government banks tided them over the most dangerous time, and fortunately prices soon began to recover, so that at the close of the year cotton-mills and copper-mine owners were once more in a state of prosperity. The rice and silk problems, however, presented far more difficulty. Measures for relieving the situation were brought forward by the Government, but before they could be passed the Diet was dissolved. Later on, in February, 1915, the Government by Imperial Ordinance authorised the Minister of Finance to make purchases of rice in such quantities and at such times as seemed suitable. The effect of this Ordinance has been to bring about the result which the Government wished, namely, to force up the price of rice to a level of 15 yen (about 31*s*.), which they considered is remunerative to the farmer, but the measure has been much criticised, both on economic and political grounds.

THE RUSSIAN SOLDIER.*

I have seen a good deal of the Russian soldier during my residence in Russia. I used to visit the barracks and the sergeants' messes, and I spent some weeks in camps of exercise with the Astrakan regiment of the Russian Army—the 12th Grenadiers —of which the late Emperor was Chief. The regiment was originally raised by a Scot named Roman Bruce, eldest son of one William Bruce, who migrated to Russia in Cromwell's time; and the regiment was commanded, when I was with it, by a Tartar colonel, a Mohammedan. I used to find the Bible very much in evidence in the sergeants' mess, and the knowledge which the common Russian soldier possessed of the poets of his native land (Pushkin and Lermontoff, Nekrasoff and others) was simply wonderful. It is quite a mistake to imagine that Russian soldiers are as a rule ignorant and illiterate. This is not true even of the majority, and many of them may be described as well educated. But to whatever class the rank-and-file belong they make the best of things, and are wonderfully cheerful and contented. Though their pay is miserably poor (about 1½*d*. a day) and their work often very hard, you never hear them growsing or grumbling. In pluck and, I may add, in capacity for never knowing when they are beaten, they resemble our own soldiers; and as to their devotion to their native land—Holy Russia—and their Little Father—the Emperor—there is not the shadow of a doubt. They are ready to give their lives freely for both, and with them war against the Teuton enemy is a religious duty. It is strange how history repeats itself. In the battle of Kunersdorp (fought on August 1st, 1759, against Frederick the Great) this Astrakan regiment lost thirty-two officers and more than half its rank-and-file; but it was mainly due to the charge they made that the victory was won. It may be recalled that this battle of Kunersdorp first resulted in an apparent victory for the Prussians. They captured ninety guns, and drove the Russians from point to point of their position to the extreme spur or last ledge of a long ridge of low hills. Here, as evening fell, the Russians made a final stand, but Frederick was so sure of victory that he sent off a despatch to Berlin announcing the rout of the Russians (just as William II. is so fond of doing now). But "he laughs best who laughs last," says the Russian and English proverb, and the Russians had the last and best laugh. Next morning, when the Prussian battalions renewed the attack and charged up the height against the Russian position, they were received with such a murderous fire that they were driven back in all directions. The Russian soldier is never so dangerous as when standing at bay, like the bear of his native wilds, and on this occasion the Russians "greatly stood at bay." In vain the Prussians again and again renewed the assault; they fell back in confusion each time, until at last the Astrakan regiment, the Grenadiers, charged down and routed them completely. The Prussian King, Frederick the Great himself, was severely bruised in this fight (having had two horses killed under him), and was very nearly taken prisoner. The Prussian loss in killed and wounded amounted to 10,000 men, and they lost 178 guns, and some 5,000 surrendered as prisoners of war.

* Extracted from a paper on "India and Russia," read by Dr. John Pollen, C.I.E., I.C.S. (retired), before the East India Association.

The memory of this achievement still lives in the Astrakan regiment, and is cherished by the rank-and-file.

Jubilant in victory, inclined like his Indian and Irish comrade to exaggerate deeds of military daring and prowess and acts of individual heroism, the Russian soldier is seldom depressed by defeat, and is always ready to account for or minimise disaster, by declaring that the enemy was from twice to ten times as strong as himself, and that defeat was due to no fault or defect on his own part. This is, perhaps, only saying that the Russian soldier is human, but I think it ought also to be recorded and remembered that he is Christian and humane. His foes need fear no demoniacal mutilation, no dastardly cut-throat treachery, no Tartar or Teuton atrocity at his hands. His religion—nay, his very superstition if you will—has taught him the meaning of a fair field, and in dealing with Russians Christian nations ought not to forget that they have to do with intensely earnest followers of the faith they themselves profess.

But in addition to being Christian the Russians are a "singing nation," and in that fact lies much of their strength and cheerfulness. The way the Russian soldiers burst into song as they march along, struggling against vile weather and worse roads, is as inspiriting as John Peel's "Tally-ho!" As has been well said, there is perhaps no country in the world where love of song may so justly be claimed as a natural characteristic as in the great Russian Empire. Russians never sing coldly, and absence of feeling (the "teacher's despair," as it has been called) is a fault rarely met with amongst them. When they sing they put their whole heart into the song, and their sweetest songs are often those that tell of saddest thought. The Russians also love dancing, and they will dance to the concertina or the drum if no other musical instrument be available, and their country dances often reminded me of the hill-dances I have seen in India. But in Russia the women begin dancing first and the men join in afterwards, whereas in India it is just the other way.

Time would fail me to tell of the many other points in which resemblances can be traced between India and Russia; but I may just mention one great characteristic, namely, the spirit of brotherhood and equality which prevails. In the free and familiar way in which orderlies talk to their officers, and in which even Grand Dukes are addressed and accosted, in the easy and unconcerned manner in which the peasant will sit down beside the grandee on the roadside benches or on board the river steamers, or stand or kneel beside him in church, one recognises the democratic idealism of the East.

It is with a people characterised by the qualities I have endeavoured to describe that Great and Greater Britain and India are now happily in firm alliance, and from this alliance I for one look forward with confidence to great and abiding benefits both to the East and to the West, and especially to India. I have never believed in the policy of buffer-states and bottled-up harbours; and following Sir Alfred Lyall and others who knew India and her true interests well, I have for the last twenty-five years consistently advocated combination and co-operation with Russia. Until the Crimean War Russia had always been our friend and ally, and during the Crimean War it must be recalled the Emperor Nicholas protected British colonists and merchants in Russia, and allowed the British in Moscow to pray in their church there that Queen Victoria might have victory over all her enemies. Russia has always proved a generous foe and, war or no war, has never repudiated her debts.

She is in truth a great democratic Power, and she has saved Europe more than once from tyrannous foes. She has given peace to Central Asia, and is helping to revive its cultivation and civilisation. And now an abiding alliance between her and Great Britain will probably prove the best safeguard of the rights and freedom of the peoples and nations of the East, while securing the populations of the West from future wars of aggression and destruction.

ARTS AND CRAFTS.

The Slav feeling for Design.—The exhibition of Ivan Mestrovic's works at the Victoria and Albert Museum has raised a storm of criticism and approval which has attained quite large dimensions and attracted considerable attention. That is perhaps not to be wondered at, for the sculptures are decidedly unusual and original—and a few of them show characteristics which, whatever we may think of them in the work of the Slav master, would undoubtedly not bear repetition at the hands of the British students who, especially at this season of the year, flock to South Kensington. There is, however, one aspect of his work which has been but slightly touched upon, and that is its decorative quality. We have all been learning of recent years by the aid of exhibitions, as well as through books and travel, that in the minor arts the Slav is able to give a good account of himself. Some of us have come to realise that a good deal of embroidery and other craftwork which we had been accustomed to call rather loosely Hungarian, though it came indeed from the Austro-Hungarian Empire, was the work of neither of the dominant races there. It is due not to Teutons or to Magyars, but very largely to Slavs, though the work of the Rumanes of Transylvania has also to be taken into account. That being so, it is not surprising that the work of a Slav sculptor—a Serbo-Croatian by race, a native of Dalmatia—whose earliest training had been in woodcarving, should be pronouncedly decorative in feeling. This feeling is most strongly marked in his bas-reliefs where the traditions of his woodcarving technique still cling to him. The sheer cut lines of the outline in themselves suggest

the flatness of decorative convention, whilst the treatment of the details shows over and over again the artist's sure instinct for design. It has been suggested that the treatment of the wings of the angel in the Annunciation panel bears traces of his early training; it certainly shows, in its curious likeness to the wing of a Chinese embroidered butterfly, a distinct preference for decorative form. Again, the reverse of the medal in honour of the victors in the first Balkan War, with its central colossal winged figure holding in outstretched hands the heroes' crowns over the two rows of kneeling figures who, with bent heads and spears laid on the ground, await the reward of their deeds, is a fine piece of decorative composition. The large vases exhibited are also very satisfactory in shape, while the band of figures with lifted arms encircling one of them is an ideal decoration for a vase with a fairly large bowl and a slim neck, as it not only forms a pleasing ornament in itself but also helps the shape of the vessel it adorns. It recalls a Greek device but there is no servile imitation about it. The work for the temple at Kossova is on so large a scale, whilst the wooden model is so small, that it is difficult to tell how far the sculptor's decorative instincts would hold their own in his architectural work. However that might be, the works exhibited at the Victoria and Albert Museum prove his feeling for design and have very considerable value for decorators and designers.

Mr. Carter Preston's Polychrome Models.—It seems at first sight a very far cry from the heroically monumental work of Ivan Mestrovic to Mr. E. Carter Preston's polychrome models and statuettes, none of which are so much as two feet high, whilst few of them are very serious in intention. On the other hand, the artist's method of cutting his shapes with a saw and building up his models by the super-imposition of thin slices of wood does in some measure recall the sheer cutting of M. Mestrovic's reliefs, whilst his tendency to seek his inspiration from eastern sources forms another point of contact. For the rest, however, Mr. Carter Preston's technique seems to be really the outcome of a desire to express rather more than he found himself able to do by the simple process of cutting out figures in silhouette. This last method has been adopted by many artists trying their hands at toy-making, but Mr. Carter Preston has arrived, by the carrying further of it, at a mode of expression all his own. His technique allows him to reproduce exactly as many copies of his original as he considers advisable, and it further stamps his work with an unmistakable character. The wood is naturally worked in planes, and the final result is a certain squareness which in able hands has been made remarkably expressive. The only thing against it is that (especially in the case of some of the toys, though it holds good of the more serious models too), it gives one the feeling that the figures ought to be movable. It seems as if the various layers of wood must have been so put together as to allow of some play even in the case of the solid caricatures and the like; whilst the toy animals, which in many instances do move their ears or perhaps their legs, ought to quiver in every limb. The mere fact, however, that they give this impression is a striking proof of their go and vigour. The colouring of the figures is generally very happy, and such pieces as the Sun Dragon, the Aztec paperweight and the Gryphon are very full of meaning, whilst the caricatures of Marshal von Hindenburg, Mr. Lloyd George, General Joffre and the Gallic cock, Lord Kitchener and the British bull dog, are most amusing. When it comes to the studies in symbolism, the results are not quite so uniformly satisfactory. Heligoland and the Bosphorus are full of interest, but one hardly feels that the figure entitled "Who is this that cometh from Edom?" expresses quite what it was meant to convey. It represents, indeed, an Oriental potentate striding along in his majesty, clothed in garments which prove on examination to yield a wealth of symbolic meaning, but for all that the model appears rather lacking in impressiveness. It would seem that the method, eminently satisfactory as it is for toys, caricatures, and political symbolism, is hardly so well adapted to more serious themes. That is not to speak against it, but to assert that, like other methods, it has its limitations. Mr. Carter Preston's work is of very real artistic merit besides being thoroughly original. If he has not created a new art, he has at least developed an old one on very fresh lines.

Certificates in Industrial Design.—It is now over three years since the Board of Education reorganised their system of art examinations, abolished their old tests in separate subjects, and instituted in their stead an examination in industrial design which was so framed as to be suitable only for "those students who take a long and comprehensive course of study with a view to qualifying themselves as highly skilled handicraftsmen or designers for manufactures." The stopping of the old examinations, though hailed with a certain amount of relief in some quarters was on the whole a blow to the teachers who found that they helped to keep up the interest of their students until the late spring and also to the class of students who wanted for some reason or other certificates of proficiency in such subjects as geometrical drawing and freehand—though perhaps the practical usefulness of the examinations was hardly commensurate with the trouble and expense they involved. However that may have been, the new test has not attracted so far a very considerable number of candidates. It appears that the Board have come to see the need of recognising a rather less severe course of study, and are offering under certain very clearly defined conditions to endorse certificates granted by the schools to students who have made a satisfactory number of attendances and passed certain examinations conducted by the institutions concerned. They issued a circular earlier in the

year, and by this time a number of schools have sent in applications to have their certificates recognised next session and are waiting to see what happens. From one point of view there seems very little need for action on the part of the Board as the certificates are clearly not meant for teachers, and employers do not as a rule ask for such things. There is, however, a feeling that a good many students would be more diligent in their studies and more regular in their attendance if they were working for a certificate of an officially recognised standing than they are under present conditions. That being so, it is obviously far better that the certificates should be given on the result of the year's work and not simply and solely on examination results, and that they should be for success in a course and not merely in separate subjects. It is, however, in the eyes of some teachers at any rate, a pity that the provision is only for industrial certificates. The Board, indeed, grants a certificate for elementary school teachers, but it is not only elementary education that has to be taken into account with regard to the supply of art teachers, and whilst it is true that something is nowadays being done for the training of art teachers for secondary schools it can hardly be said that the problem at present has been completely solved. The old art class teacher or art master's certificates were certainly not ideal tests—nor, for the matter of that, were the private certificates with which many teachers in day schools supplemented them—while the question of capacity to teach was not taken into account at all; but there does seem to be room for some sort of certificate rather less advanced than was contemplated in 1911, implying that the holder has had a good all-round grounding in the principles of art with or without the further qualification of being competent to pass on his own knowledge to others. The industrial students as a class are just those who have least need of certificates.

OBITUARY.

LORD GLANTAWE.—The death of Lord Glantawe, who was in his eighty-first year, took place on the 27th inst., after a long illness, at his residence, The Grange, near Swansea.

John Jones Jenkins was born at Clydach, Glamorganshire, in 1835. He began life as a tin-house boy at Upper Forest Works, near Clydach. At a very early age he displayed great business ability, became interested in a number of industries, and was soon regarded as an authority on the Welsh tinplate trade. He also took a leading part in the administrative work of Swansea and district. He was for many years Chairman of the Rhondda and Swansea Bay Railway Company, and guided its fortunes in its struggles with the Great Western Railway Company. He was Chairman and chief proprietor of the Swansea and Mumbles Railway and Pier, and did much to promote the popularity of Mumbles as a health resort. He served as a magistrate and High Sheriff of Glamorganshire, and was three times Mayor of Swansea. During his tenure of this office he had the honour of entertaining King Edward VII. and Queen Alexandra (then Prince and Princess of Wales) on the occasion of the opening of the Prince of Wales Dock, and it was then that he received a knighthood. In 1895 the freedom of Swansea was conferred upon him in recognition of thirty years' public services.

In 1882 Sir John Jenkins was returned to Parliament as Liberal representative for the Carmarthen Boroughs. In 1886 he became a Liberal Unionist, and as such was twice defeated; but in 1895 he regained his former seat and sat in the House of Commons as a Unionist till 1900. He was raised to the peerage in 1906.

Lord Glantawe had been a member of the Royal Society of Arts since 1873.

HENRY ROBERT WARING, M.INST.C.E.—Information has been received of the death of Mr. Henry Robert Waring, which took place in Palma, Majorca, at the age of eighty-two. Nearly the whole of his life was spent in Spain. Originally he was employed in surveying and engineering work in connection with the North of Spain railways, principally about Bilbao and Santander. Whilst he was engaged on this work the Carlist wars broke out and raged with special fury in these parts. Mr. Waring had many narrow escapes from capture, but he finally succeeded in getting away in safety to the east of Spain, and after a few years he obtained the post of managing director of the Majorcan Land Company. This company owned some 8,000 acres of bog land in the island, which, by systematic drainage, has been converted into the most fertile land in Majorca. Mr. Waring retired from active business some twenty-five years ago.

He was elected a member of the Royal Society of Arts in 1907.

DAVID MCHARDY.—Mr. David McHardy died suddenly at his office in Aberdeen on the 23rd inst. at the age of seventy-seven.

He was born in Aberdeen, and educated at the West End Academy, the Grammar School, and the Mechanics' Institute of his native town. He entered his father's works in 1853, and after serving an apprenticeship of six years, and spending three more as a journeyman, he was admitted as a partner. On the retirement of his father twenty years later, he assumed sole control of the business, that of furnishing ironmongers, and under his guidance the firm prospered greatly.

Mr. McHardy was deeply interested in art, particularly as applied to ironwork and kindred subjects. He joined the Royal Society of Arts in 1896, and was also a member of the Aberdeen Philosophical Society. He was also a keen horticulturist and meteorologist, and for many years he served as a Justice of the Peace for the city of Aberdeen.

NOTES ON BOOKS.

THE WORLD'S COTTON CROPS. By John A. Todd, B.L. London: A. & C. Black, Ltd. 10*s.*

The aim of this book, in the author's own words, is "to give, as briefly and comprehensively as possible, an account of the sources of supply of raw cotton in a form sufficiently non-technical to be understood alike by the average grower and consumer, so that the former may learn something of the final destination and use of his crop, and at the same time may know what rivals he has in other countries; while the latter may understand the conditions under which his raw material is produced, and be able to estimate the prospects of the future supply from existing fields, or the possibilities of new sources of supply."

To give some idea of the nature of this task, it may be as well to borrow a few of Professor Todd's statistics. In the year 1902-3 the world's supply of cotton was 17,636,000 bales of 500 lbs. each. Huge as this figure is, it has rapidly risen until in 1913-14 it reached the total of 27,703,000 bales. Nor does the demand show any signs of having approached a final maximum. On the contrary, everything points to its continued and rapid increase. The spread of civilisation, with the consequent demand for more and better clothing, is mentioned as one of the principal factors. "According to a statement attributed to the U.S. Department of Agriculture, it is estimated that of the 1,500,000,000 of the world's population, one half are still only partially clothed, while about 250,000,000 wear practically no clothes at all. Of the clothing actually worn, nine-tenths of the raw material is cotton. The potential demand of the world for raw cotton is therefore almost unlimited."

Besides this, cotton has been found to be a satisfactory substitute for a number of other raw materials. Table and bed "linen," shirts, handkerchiefs, "flannels," tweeds, are largely made of cotton, especially in the Continental ready-made markets; many new uses for it have been discovered lately, *e.g.*, webbing for motor-car tyres, type-writer ribbons, yacht and aeroplane sails, etc.; while most important of all is the great improvement that has been made in the quality of goods that can now be made out of cotton. "Fine white cotton goods, such as nainsooks, madapollams, etc.; fine cotton nets, laces, and curtains; beautifully-finished coloured cotton fabrics, such as dress linings and dress materials of excellent quality and appearance, can now be turned out at prices bringing them within the reach of a class of consumers by whom such goods were a few years ago utterly unattainable."

To supply this enormous demand, immense areas are under cotton in many parts of the world. Professor Todd gives a very interesting account of these various crops. Though he modestly disclaims any pretension to be a botanist or an agriculturist, he has been for years a keen student of economics. He now occupies the chair in that subject at University College, Nottingham, and before he was appointed to this post he spent five years at the Khedivial School of Law in Cairo at a period when, as he truly remarks, economics and cotton were almost synonymous in Egypt. On this account his description of the Egyptian crops is perhaps somewhat more exhaustive than his treatment of some other countries; but he has visited practically the whole of the American cotton belt, and in all cases he has taken the greatest care to have his work revised and checked by first-hand authorities. The result is a highly interesting and valuable book, which will be recognised as a standard work among those engaged in the multifarious branches of cotton industry.

LEVELLING AND ITS GENERAL APPLICATION. Third Edition. By Thomas Holloway. Revised by H. T. Tallack. London. E. & F. N. Spon, Ltd. 2*s.* 6*d.* net.

The first edition of this work appeared in 1886, and was at once welcomed as a handy and practical guide for students of levelling. It has now reached its third edition, for which it has been revised and brought up to date by Mr. H. T. Tallack It gives a clear account of the various instruments used in levelling, and of the numerous problems which a surveyor may expect to meet in carrying out his work. The collection of examination questions at the end of the book will be found useful by students who wish to test their knowledge of the subject.

GENERAL NOTES.

ELECTRICAL MUSEUM.—In response to the appeal which was issued some time ago by the Institution of Electrical Engineers, a number of examples of electrical apparatus of historic interest have from time to time been received. Some of these are now exhibited in the institution, including several early dynamos, an historic series of glow lamps, a collection of supply meters from the earliest types, fuses, and switches; also telegraphic and telephonic apparatus. The collection, though making substantial progress, is still far short of what it should be in order to be thoroughly representative of the early days of the electrical industry. Owing to the many changes, necessitated by the war, that are now taking place in various works, the present is a time when obsolete types of apparatus and early forms of instruments are likely to be thrown out of use, and thus might readily become available. Hence, with the desire of retaining for the benefit of future generations of the profession, objects of historic interest that are still in existence, and which might otherwise be irretrievably lost, the council of the Institution of Electrical Engineers are inviting members and their friends to co-operate by presenting apparatus suitable for the museum. Early forms of electric motors, arc-lamps, and measuring instruments are desired. A Jablochkoff alabaster candle-holder is also wanted.

Persons in possession of suitable objects are invited to send information regarding them to the Secretary of the Institution of Electrical Engineers, Victoria Embankment, W.C., and to state whether they would be prepared to present some or all to the institution, or to deposit them on loan in the museum.

THE NATIONAL PHYSICAL LABORATORY.—The effects of the war are naturally reflected in the Report of the National Physical Laboratory for 1913–14. To begin with, about a quarter of the staff has left for active service. International work of all kinds has practically come to a standstill, while with regard to test work, although the aggregate has sunk, there has been a great increase in certain directions, especially in the departments of electro-technics and optics. One or two recent fires at sea, notably that on the "Volturno" in 1913, have been set down to the presence of barium peroxide in the cargo, and the Board of Trade entrusted the Laboratory with an investigation into the conditions under which this material might take fire; this has resulted in the issue of special instructions for its storage on board ship. The importance of research into the manufacture of optical glass has led the Board of Trade to invite the director to prepare a scheme of research at the Laboratory. Assistance has also been given in a number of ways to the Home Office, the India Office, the Post Office, the Office of Works, and the Crown Agents. An investigation into cracks which have shown themselves in the masonry of the Tower of London promises to be of interest. The statement of work proposed for the year 1915 16 covers an extensive and interesting field.

THE GREAT AQUEDUCT IN APULIA.—The last report of the Italian Minister of Public Works gives some interesting particulars respecting the progress of the great Apulian aqueduct, which, when completed, will furnish a plentiful supply of water for irrigation, motive power, and urban purposes in the region known as the Apulia, in the south of Italy. The main channel, which is 214 kilometres (132 English miles), of which 97 kilometres (50 miles) are tunnel, is now completed. One of the principal branch canals—that in the province of Lecce—is finished, and another in the province of Foggia, 46 kilometres (28 miles) long, is well in hand. Three hundred and twelve kilometres (193 miles) of the channels belonging to the secondary network, of which 19 kilometres (12 miles) are in the province of Foggia, and 268 kilometres (166 miles) in that of Bari, are also finished. Besides this, 48 kilometres (29 miles) of urban conduits for the water supply of numerous small towns and villages in the province of Bari are nearly ready, whilst those in the province of Foggia have just been commenced. Thirty reservoirs in the province of Bari—6 in that of Foggia and 4 in Lecce—are also nearing completion, together with 15 important works for raising water. There still remain no fewer than 1,300 kilometres (about 800 miles) of secondary conduits, in order to complete the network for the distribution of water for agricultural purposes, and 750 kilometres (465 miles) of urban conduits for supplying the various towns and villages with potable water from the River Sele.

IPECACUANHA.—According to a Bulletin issued recently by the Department of Agriculture in the Federated Malay States, the ipecacuanha crop has proved highly profitable in Malaya; but the demand is said to be small, and over-production would result if attempts were made to cultivate it on a large scale. Plants at Kuala Lumpur have done well, but it is stated that they will need great care and attention in order to obtain successful results.

QUEENSLAND MINERAL INDUSTRY.—As was expected under the abnormal circumstances of the year, there was a serious falling-off in mineral production in Queensland in 1914. According to an advance report issued by the Acting Under-Secretary for Mines, the actual value of the total output of minerals was £2,976,280, a decrease of £881,601 as compared with 1913. In addition to the disturbing influence of the war, which may be regarded as the chief cause of such a large decrease, the output was seriously affected by the closing down of the Chillagoe, Great Fitzroy, and Mount Perry works and mines, and, later on, of the Mount Elliott works, as well as by a poor market during a portion of the year for the principal of Queensland's industrial metals. In coal alone was there a satisfactory year, and an increase in production. The gold output showed some slight improvement towards the end of the year, and this has been maintained since its close. It is pointed out in the report that the outlook for the current year indicates that it will at least be better than the preceding period, and may prove very much better.

NEW METHOD OF GROWING CORN.—According to the United States *Experiment Station Record* (Vol. XXXI. No. 7), corn has been planted successfully under dry land conditions in Western Kansas by the following method. The seed is sown in rows twice the usual distance apart, while the plants are twice as thick in the row. The stand is, therefore, the same, but as this method seems to preserve the moisture midway between the rows, the supply is often sufficient to maintain the corn in a flourishing condition during temporary periods of drought, while occasionally it may complete the development of the crop. It is noted that by this method the yields were about thirty bushels per acre, while in adjoining fields, in which the rows were 3½ ft. apart, the yields were only 10 to 12 bushels per acre.

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PROCEEDINGS OF THE SOCIETY.

FOTHERGILL LECTURES.

MODERN MUNITIONS OF WAR.

By Professor Vivian B. Lewes, F.I.C., F.C.S.

Lecture I.—Delivered July 7th, 1915.

Guns and Propellants.

The teaching of the first six months of the war was tersely summed up by General French when he said last February: "The problem set is a comparatively simple one—munitions, more munitions, always more munitions," the special munitions meant in this case being the high explosive shells that from the time the war assumed the conditions of a field siege, after the battle of the Aisne, became a necessity for any advance.

When in days to come we review dispassionately the history of the war, and when events have settled down into their proper perspective, we shall see that the wonder of it has been that the supply of munitions has been so good that, in spite of the gigantic dimensions that the war has assumed, our supplies have been kept up far better than in any war of the past, and that any shortage that there has been in any one direction has been due to the entirely new conditions created, which find no parallel in the history of the world.

This phase of the question of munitions will be discussed fully under the subject of the various types of shell, but first it is necessary to make clear the changes in guns and propellants that have brought modern artillery to the paramount position it occupies in this war.

In order to gain an idea of the true proportion of the changes that have occurred, we must carry our minds back to the middle of the last century, when in the Crimea the English and French were struggling as hard to keep the Russians out of Constantinople as they are to-day fighting in the Dardanelles to help them in; and we must contrast the old smooth-bore 68-pounders, using a charge of 16 lb. of black powder, that were the largest guns ashore or afloat at the time of the Crimea, with the 15-in. guns of our super-Dreadnoughts, weighing close on 100 tons, from which a charge of 400 lb. of M. D. cordite hurls a projectile weighing 1,925 lb. with accuracy to a distance of fifteen miles, or with high-angle firing to double that distance.

The changes commenced in the fifties of the last century, when we adopted the idea of rifling ordnance, so as on firing the gun to give the projectile a spin as well as forward velocity. This was found to add to the range and accuracy of fire, and in order to do this satisfactorily the guns had to be increased in length.

The rate at which the size of the big naval guns grew may be gathered from the fact that at the siege of Alexandria in 1882 we had the 80-ton guns of 16-in. calibre, whilst by 1886 we had afloat the 110-ton guns, with a bore of 16·25 in., using a charge of 960 lb. of powder.

Up to this time nothing but gunpowder had been used either as a propellant to drive the projectile from the big guns, or as bursting charges for shells, and the grain used in the smooth-bore 68-pounders was that known as "rifle large grain." It was soon found, however, that the lengthening of the gun caused, with this size of powder, a strain on the breech, and gave but a low muzzle velocity, this being due to the too rapid burning of the powder. Attempts were then made to decrease the rate of combustion by increasing the size of the grain, and with the increase in the size of the guns the powders gradually grew to the large pebble powder, consisting of 1½ inch cubes. Unfortunately the desired effect could not possibly be obtained by alterations of this character, as it is required of a perfect powder that when the charge is fired in the breech of the gun the combustion shall commence comparatively

slowly, so as gradually to overcome the *vis inertiæ* of the projectile without throwing too great a strain on the gun, and shall then increase in rapidity so as to supply gas more and more rapidly to increase the pressure and the momentum of the shot, which should leave the muzzle of the gun with the maximum velocity.

With such forms of powder as cubes or other large grains, however, maximum rapidity of burning and evolution of gas takes place at first, owing to the ignition spreading over the whole surface of the cubes, and instead of the gas coming off with more and more rapidity as the space in the gun became larger, the evolution rapidly diminished with the decrease of surface caused by the burning away of the powder.

In order to avoid this defect as far as possible, built-up charges were resorted to, and it was General Rodman, of the American Service, who first tried to overcome the difficulty by building up the charge of solid slabs perforated with holes, from the interior of which the combustion was started, so as to expose the minimum surface of powder at first, whilst the enlarging holes produced a greater and greater surface of powder to burn and give off gas, as the space behind the projectile increased.

Large perforated cakes, however, are always liable to break, and cannot be made of uniform density, so that it was found far better to mould the powder into hexagonal prisms, with a central core through them, which could be built up into a charge, the prisms being made with such exactitude that when the charge was fired by a layer of fine grain powder at the base of the cartridge, the combustion started from the central cores, and as the powder burnt away a greater and greater surface for combustion was continually formed, until the whole of the charge was spent.

With the continued growth, however, in the size of the guns employed, other changes became necessary, as even when using the black prism powder for built-up charges the pressure given began to throw too severe a strain upon the breech of the gun, even when the cartridges were made up in such a way as to leave air spaces at the seat of the charge, in order to relieve, as far as possible, the initial pressure; and to secure further modifications, alteration in the composition of the powder became necessary, so that by the time the 80- and 100-ton guns were introduced into the Naval Service, prism powder, containing an increased percentage of potassium nitrate and charcoal, with a smaller proportion of sulphur, was in use.

This fitting of the powders to the guns enabled perfect ballistics to be obtained, and really converted the explosive into what Sir Frederick Nathan was fond of calling these powders—"propellants."

These powders had one characteristic, however, in common with the old grain powder, and that was that they gave volumes of smoke; and when rapid-firing guns were introduced, so dense was the cloud produced, that after the first few rounds nothing could be seen, and the guns became useless until the smoke had cleared. This rendered a smokeless powder a necessity, and the history of the inception of the smokeless powders of to-day is full of interest.

In any successful explosive certain conditions have to be fulfilled: one must be able to concentrate in a small space bodies which will act upon each other independently of the air with enormous rapidity, forming the largest possible volumes of gas, which, expanded by the heat of the action and having to find a way for itself, gives the explosive effect. If this change takes an appreciable time, the body can be used as a "propellant" in a gun, and gunpowder is of this character. When, however, the change takes place practically instantaneously, it cannot be used in a gun, and is used in high explosive shells, bombs, torpedoes, and mines, and such bodies we call "high explosives," nitroglycerin being an example of this class.

When during the formation of the gas from the solid in explosion other solid compounds are formed as well, these solids are blown out in a fused form as fine particles, and form a cloud—smoke; but if only gases are produced the explosion is smokeless. Gunpowder, on being fired, gives nearly half its weight as solids, and therefore forms clouds of smoke; guncotton is resolved entirely into gases and gives no smoke.

When the necessity for a smokeless powder became urgent, it was naturally to nitrocotton that attention was most largely turned; but all attempts to convert it from an "explosive" to a "propellant" failed, until it was found by Mr. Walter Reid that its rate of combustion could be slowed down sufficiently to make an excellent propellant by destroying the original cotton structure that still existed in the nitrocotton by gelatinising it with alcohol and ether. If cotton fibre is examined under the microscope

it is found to consist of very minute tubes, and in the process of converting the cotton into "guncotton"—by soaking it in a mixture of the strongest nitric and sulphuric acids, washing out all acid and drying—this structure remains. If the guncotton were used as a charge in a big gun, no matter how much it was compressed, the flame of the combustion would be pressed back into these tubes, and so accelerate the burning as to give almost instantaneous explosion, straining the gun and giving very low velocity to the projectile.

Nitroglycerin is an even more rapid "explosive" than guncotton, and if used in a gun would burst it, probably without driving out the projectile at all. Nobel, however, in 1875 discovered that if a low form of guncotton was macerated in nitroglycerin, the guncotton was gelatinised, all structure disappeared, and both explosives became so tamed in their action that they were converted into a perfect blasting explosive, and in 1888 the mixture was made the basis of a smokeless propellant far superior to gunpowder. This idea was improved upon by Sir Frederick Abel and Sir James Dewar, who found that the highest form of guncotton, which is unacted upon by nitroglycerin, could be got into a gelatinised mass with nitroglycerin if a common solvent, such as acetone, was used to blend them, and afterwards evaporated out; and this blend, with 5 per cent. of vaselin to increase the stability and lubricate the gun, forms our modern "propellant" cordite, so named from the fact that it is cast into sticks, rods or cords, according to the size of the gun in which it is to be used.

The "Mark I" cordite first made contained 68 per cent. of nitroglycerin, and the heat of its combustion in the guns gave rise to a troublesome form of erosion, which in the South African War shortened the lives of the field guns, so that they had to be relined after a certain number of rounds had been fired. This led to an alteration in the proportion of the ingredients in the M. D. cordite now used in all arms, from the 15-in. guns of our super-Dreadnoughts to the Service rifles.

Our allies and enemies alike use smokeless powders of a somewhat different type, made by gelatinising nitrocotton without any nitroglycerin, for their field artillery and rifles; but in the German and Austrian naval guns nitroglycerin powders of much the same kind as our "cordite" are used, as a larger charge of nitrocotton powder has to be employed than of a nitroglycerin powder, and this means larger chambers in the guns and larger magazines to carry the necessary amount of explosive.

As may be imagined, the introduction of smokeless powders made an immediate change in gun construction, as much smaller chambers were needed, and the possibility of throwing the pressures further forward in the gun enabled guns to be made lighter. As a result our biggest naval guns are only 15 in., as against the 16·25-in. 110-ton guns in use in 1886, and the charge of M. D. cordite only 400 lb., as against the 960 lb. of prism powder, but the muzzle velocity has increased by nearly 50 per cent., whilst the projectile is far heavier.

Our enemies in the field are using guns, howitzers, and mortars, the two latter classes being used for indirect fire from behind shelter, for which their high trajectory specially fits them, whilst the field artillery used by them consists chiefly of quick-firing 77 millimetre guns (3·03-in.). One of the new features they have introduced into the present warfare is the use of siege guns of much larger size, transported by motors, and so made available for field work, whilst amongst the other artillery in use are the celebrated Krupp siege howitzers of 16·8-in. calibre; but probably the most deadly innovation has been the almost unlimited use of machine guns, to the manufacture of which the Germans have devoted many years, and of which they have an enormous supply.

Lecture II.—Delivered July 14th, 1915.

SHELLS AND HIGH EXPLOSIVES.

In the last lecture the propellants used in the guns during the present war were dealt with, and it was seen that although for field artillery and rifles our allies and enemies were both using nitrocotton powders, yet in nearly every case, for naval warfare, owing to restricted magazine space, nitroglycerin powders of the character of our Service propellant "cordite" were employed, as a smaller charge is needed to obtain the same muzzle velocity. For instance, with the German 15-in. gun, to give a muzzle velocity of 3,000 foot-seconds, the charge of nitrocotton that has to be employed is 695 lb., whilst with one of our own 15-in. guns a charge of only 400 lb. is employed.

Ever since war was declared the explosive factories all over England have been working in unison and have kept up an ample supply of propellants, whilst in nearly every works extensions are being erected, which in early autumn will yield an almost inexhaustible quantity.

The shells used in big guns and field artillery may be divided into two main classes: shrapnel, which is utilised against troops in the field and which is of but little use against fortifications or trenches, and high explosive shells, which may be either armour-piercing or ordinary.

The shrapnel shell is a hollow, cylindrical steel projectile, packed with bullets, at the base of which is a bursting charge that may be gunpowder or high explosive, whilst in the nose of the shell is arranged the time fuse, connected by a tube to the bursting charge. This can be so regulated that the shell explodes in the air at any desired point, the bullets and fragments of the shell being driven forward and spreading over a considerable area. The shrapnel used in the ordinary field gun is an 18-lb. projectile, containing 375 bullets, and when burst at the right altitude is a most deadly weapon against troops, especially when in massed formation, and ever since its invention by the officer whose name it bears it has been looked upon in the Services as the form of shell most necessary in field operations. During the present war our supplies have been ample for all requirements.

For fortified trench warfare, such as has been the characteristic feature of the fighting on the western front since September, shrapnel is not effective, as it does but little damage to earthworks, wire entanglements, and other defences, and this practically new phase of field warfare has to be met by the use of high explosive shells, capable of detonating with such enormous concussive power as to destroy physical obstructions, crumble earthworks, clear wire entanglements, and reduce the defenders in the trenches to a dazed and stunned condition by the action of concussion on the heart and nerves.

Under the conditions created in the present war both classes of shells are needed in the field—the shrapnel to resist infantry attack, the high explosive shells to clear the ground and prepare the way for attack on the enemy, and it has been an insufficiency in the supply of the latter which has given rise to so much criticism, mostly undeserved and wholly unwise. At the present time obstacles to supply in all directions have been surmounted, and a steady and increasing stream of shell is flowing to the front.

The high explosive shell is made of forged steel with comparatively thin walls and a heavy bursting charge, but the large naval shells and those for the siege guns, which have to penetrate heavy armour, are made from ingots of chrome or chrome-nickel steel, forged, hardened, with the nose capped with soft steel, which prevents the shell from shattering on impact with the hardened steel armour. These shells also contain a heavy charge of high explosive, generally cast into the shell in a fused condition.

All these forms of shell are fitted with the usual soft copper driving bands near the base of the shells. These bands take the place of the projections used in the early forms of shell to fit the rifling of the gun. The copper band under the pressure existing during the firing of the charge is pressed into the grooves of the rifling in the gun, not only imparting rotation to the projectile, but also acting as a gas check to prevent the rush of the gas past the projectile, an action which had accentuated the serious erosion with the Mark I cordite.

For trench fighting the grenade has now again come into use, and the most modern forms are in reality miniature shrapnel shells, which are fitted on to a rod that can be fired from a rifle, or, where the trenches are close together, can be thrown or slung by hand. The body of the grenade is made of steel or malleable iron, so serrated as to break up on explosion into many pieces. It contains a charge of a T.N.T. explosive, and a tetryl detonator fired on impact by a needle liberated only after the grenade has travelled a certain distance, so as to render premature explosion impossible. The weight of such a grenade is about 23 oz., and when fired its range would be about 300 yards, but when hand-thrown not more than 40 or 50. Its flight through the air is steadied when fired by the rod, which for hand use is replaced by a rope tail.

The difference between a "propellant" and a "high explosive" is entirely one of rapidity in explosion. In both cases they are bodies containing in a small space combustible material that can be burnt to form enormous volumes of gaseous products, together with oxygen-bearing radicals capable of carrying on the combustion with great rapidity independently of the exterior air. We have seen that there was in gunpowder carbon in the form of charcoal, mixed with sulphur and potassium nitrate, the latter being the oxygen-carrying body, and on the powder being ignited a chemical action took place, which liberated an amount of gas many hundred times the original volume of the powder. This conversion took a measurable time for its completion, and a "propellant" was the result. On the other

hand, when cotton is treated with the strongest nitric acid mixed with sulphuric acid, the cotton fibre becomes nitrated, and a molecule is produced in which there are present the hydrogen and carbon of the cellulose, together with oxygen held in combination by the inert nitrogen of the nitrate radical. On such a compound being ignited it burns, as we saw in the case of guncotton, with considerable rapidity; but in a gun the rate of combustion is often accelerated, and a still more rapid form of explosion takes place.

It was in 1868 that one of Sir Frederick Abel's assistants, Mr. E. O. Brown, discovered that when a mercuric fulminate cap was exploded in contact with compressed guncotton the unconfined mass exploded with enormous violence, and that whereas an ordinary train of guncotton would take several seconds to burn a few feet, yet if compressed guncotton were detonated the explosion travels at the rate of 200 miles a minute, and as there is no time for the displacement of the air, the enormous volume of gas created having to find room for itself gives as great a destructive effect as if the guncotton had been tamped into a bore-hole in the object to be destroyed. Bodies which are capable of this accelerated form of explosion are said to be "high explosives," and unless the tendency to detonate can be overcome, as in the making of cordite from nitroglycerin and nitrocotton, they cannot be used as propellants, as there would be no time to overcome the *vis inertiæ* of the projectile and the gun would be either strained or burst.

Nitroglycerin is a very good example of a high explosive, but practically is of no use in Service work outside the manufacture of cordite, as it is far too dangerous to handle, and if used in a shell would be liable to premature explosion. It must always be remembered that science could provide explosives more powerful than those in Service use were it not quite as important to ensure safety for those using the explosive as to obtain destructive effects on the enemy.

With most of these high explosives the explosion gives rise to its greatest effects in a downward direction, which may be explained by the fact that the decomposition is so enormously rapid that there is no time to displace the atmosphere, and the recoil from the attempt to push up an elastic medium like air causes the smashing down of rigid bodies below the seat of the explosion.

One of the things that strikes the ordinary observer most when considering the composition of the explosives of to-day is that they are all derived from substances of the most commonplace and harmless description. We have seen that cotton and glycerin when nitrated and blended with vaselin yield cordite, which serves as a propellant in all our guns, whilst the high explosives used in shells, torpedo heads, mines, and aviators' bombs, are almost entirely derived from coal tar derivatives by nitration.

When coal tar is subjected to fractional distillation the portion which comes over up to a temperature of 150° C. is called "light oil," and contains all the compounds of low boiling-point found in the tar, and, as we shall see, from this several of our most valuable explosives can be obtained. When these light oils have distilled over, the next fraction or "middle oil" yields phenol or carbolic acid, a body which when nitrated gives picric acid, the basis of the French high explosive melinite, the Japanese shimose powder, and the English lyddite.

In the manufacture of picric acid the fraction coming over on the distillation of the tar between 150° and 200° C., after the naphthalene has been allowed to settle out on standing, is agitated with a solution of caustic soda, which forms sodium phenolate with the carbolic acid. This sinks to the bottom of the vessel and is drawn off and treated with sulphuric acid, whereby the carbolic acid is set free. The acid mixture is fractionally distilled, and the phenol comes over between 180° and 190° C., crystallising from the distillate in needle-shaped crystals.

Phenol or carbolic acid when pure fuses at 42° C. and boils at 182° C.

The phenol is mixed with an equal weight of concentrated sulphuric acid, and heated in an iron vessel to a little over 100° C. When cold the mixture is dissolved in twice its weight of water, and added gradually to three times its weight of strong nitric acid, precautions being taken to prevent undue rise of temperature; when fuming has ceased steam-heat is employed to complete the nitrification. On cooling, crystals of picric acid separate out and can be purified by recrystallisation.

Picric acid is a nitro-substitution product, three atoms of the hydrogen in the original phenol being replaced by the radical nitryl, and it forms with metals a class of salts called "picrates." The potassium salt was suggested as a bursting charge for shells nearly fifty years ago, whilst Sprengel showed it could be detonated, and, later, Turpin employed the acid itself as an explosive. It was found

possible to get a great weight of explosive into a small space, as the acid could be melted and poured into the shell in a molten condition. Picric acid *per se* is a very safe explosive, but has the drawback of acting on metals to form picrates, some of which are far more sensitive to disturbing influences than the acid itself.

Experiences with lyddite shells in the South African War showed their behaviour to be very erratic, some exploding with great effect whilst others gave disappointing results. This was due to the fact that picric acid requires a powerful detonator for obtaining the highest explosive effect, and the use of such a detonator was dangerous and might cause a premature explosion of the shell within the gun.

The disadvantages inherent in the use of picric acid led to attempts being made to replace it by some other material of the same character, which could be used as a high explosive in a bursting charge and yet be free from these drawbacks. Such a body has been found in trinitrotoluol, and although its explosive force is slightly less than that of picric acid, the pressure of the latter being 135,820 lb. on the square inch as against 119,000 for trinitrotoluol, yet its advantages more than compensate for this difference. Not being of an acid nature, trinitrotoluol, or T.N.T. as it is termed, cannot accidentally form more sensitive salts, it is without action on metals, and is perfectly stable.

Trinitrotoluol is obtained by the nitration of toluene, which is contained in the crude benzol distilled from coal tar and washed out from coal gas, and forms one of the group of so-called aromatic hydrocarbons. The crude benzol contains roughly—

Benzene	50 per cent.
Toluene	36 ,,
Xylene	11 ,,
Other bodies	3 ,,

The toluene is obtained by careful fractionation of the crude benzol, the boiling-point being intermediate between those of benzene and xylene—

	Specific gravity.	Boiling-point.
Benzene	0·886	80·5
Toluene	0·869	110·0
Xylene .	about 0·87	137 – 140

When coal is distilled at the lowest possible temperature the tar is fairly light as regards specific gravity and of an oily character, is rich in paraffin hydrocarbons, and contains but few aromatic hydrocarbons. The distillation of a ton of coal yields about 20 gallons of such tar, the constituents of which are even of greater value than those of the high-temperature tar made in the gasworks and coke ovens of the Empire. On now raising the temperature of distillation of the coal to about that which used to be employed in the days of the old iron coal-gas retorts, a volume of coal gas, amounting to about 9,000 cubic feet, is yielded, the coke is harder in quality, and the tar shrinks from about 20 gallons to about 16 gallons to the ton. Tar made at this temperature contains a much higher proportion of aromatic hydro-carbons than that made at the lower temperature, and it is possible to obtain nearly a gallon of toluene per ton of coal distilled by recovery from both the tar and gas.

At the temperature used in practice at the present time for the manufacture of both coal gas and metallurgical coke, which is as high as the materials of which the retorts and ovens are constructed will stand, the aromatic hydrocarbons are largely destroyed or converted into naphthalene, and a third of a gallon of toluene is all that can be obtained from the tar and gas yielded by a ton of coal.

Toluene, to be used for the manufacture of trinitrotoluene, should be a clear water-white liquid, free from any suspended solid matter, and having a specific gravity of not less than 0·868 or more than 0·870 at 15·5° C. Its boiling-point must approximate closely to 110° C., and 90 cc. shaken with 10 cc. of 90 per cent. sulphuric acid for five minutes should give only a slight colour in the acid layer after settling.

The preparation of trinitrotoluene is carried out in three distinct stages, the toluene being converted first into the mono-nitro compound, which is then further treated with nitric acid at a slightly increased temperature to convert it into the dinitrotoluene, this being finally nitrated in sulphuric acid solution with strong nitric acid to trinitrotoluene.

On a large scale, trinitrotoluene is manufactured commercially from the orthonitrotoluene by a sulphonating process of the same character as that used in the manufacture of picric acid, and the crude crystals obtained in the final nitration are purified by solution in alcohol, filtration, and recrystallisation, the crystals being freed from alcohol in a centrifugal machine and air-dried.

Trinitrotoluene when pure has no odour and is a yellowish crystalline powder, which darkens slightly on keeping and has a melting-point of 81·5° C.; the presence in it, however, of isomers

lowers its melting-point to 79° C. It is perfectly stable and unaffected by contact with metals, forming no compounds with them even in the presence of moisture. It cannot be exploded by flame or strong percussion, and a rifle bullet may be fired through it without any effect on the mass. When heated to 180° C. it ignites and burns with a heavy black smoke; but when detonated by a mercuric fulminate detonator the explosion is of great violence, and gives the heavy black smoke which has been such a characteristic of the high explosive shells used in the present war. Even when detonated under water, as has been the case on several occasions with bombs aimed by aviators at vessels, a column of black smoke is thrown up above the surface of the water.

The formation of these volumes of black smoke on detonation of the T.N.T. has given rise to the names given to shells containing this explosive of "Black Marias," "Coal boxes," and "Jack Johnsons," and the fact that this cloud of carbonaceous matter is produced shows conclusively that the oxygen contained in the nitryl radical present in the explosive is insufficient for its complete combustion. An excellent explosive used during the Balkan War, and now largely employed by the Austrians and Russians, is known as ammonal, in which 12 to 15 per cent. of T.N.T. is mixed with an oxidising compound, ammonium nitrate, a little aluminium powder, and a trace of charcoal. This mixture gives even better results than the T.N.T. alone, and its only drawback is the hygroscopic character of the ammonium nitrate, which necessitates the material being made up in air-tight cartridges. It forms, however, a most effective bursting charge, and although the rate of detonation of the trinitrotoluene is reduced by the admixture of the oxidising compounds, the shattering effect is even more destructive than when the explosive is used alone, as the pieces of shell scattered are larger in size.

An improved form of this explosive is being made on a large scale in England for use by the Allies, and renders the supply of high explosives for shells perfectly adequate.

Toluene is also being produced synthetically from other hydrocarbons by the action of heat and pressure, and it is safe to say that any requirements for toluene to nitrate can be amply met.

Under the influence of nitration other constituents of tar are converted into effective explosives, dinitrobenzol being the basis of such mining explosives as "Roburite" and "Bellite," whilst trinitrocresol has been used largely in place of picric acid under the name of "Ecrasite," but it shares with picric acid the drawbacks of forming more sensitive compounds with bases, and of having an acid reaction.

Expert opinion has by no means settled which is really the best of the high explosives, and although it was the Germans who were chiefly responsible for bringing T.N.T. into such prominence, there are not wanting signs that they are largely reverting to picric acid.

Probably the most powerful explosive known is made from benzene by converting it into anilin, and by nitration making this into tetranito-anilin, an explosive of which a great deal more will be heard, whilst another derivative, tetranitromethylanilin, known as "tetryl," is being used largely for detonators in place of mercuric fulminate.

It has already been mentioned that the great value of the high explosive is the terrible concussion transmitted through the air by the detonation, which numbs, and often kills, the defenders in the trenches without their being struck.

The effect of the concussion frequently shows itself by loss of memory, by nervous breakdown, and by heart trouble, many cases occurring in which men have been disabled without been killed, and have afterwards been found to be suffering from serious displacement of the heart. In the early stages of the war the fact that men were killed without being wounded gave rise to wild rumours of intensely poisonous shells, so fatal in their results that men and animals were found in the exact positions in which death had overtaken them. One ingenious correspondent christened this explosive "Turpinite," and devoted a long article to the effects produced, which made it clear to anyone with knowledge of the subject that concussion, and not poison, could have been the only explanation of the deaths produced by it.

Lecture III.—Delivered July 21st, 1915.

Poison Gases and Incendiary Bombs.

The use of asphyxiating gas in warfare, as long as the effect was merely to drive men from the trenches, to produce coma, or inflict death without excessive suffering, would be but little more horrible than the legitimate methods of fighting; but the use of gases which, if they

fail in the intended effect, produce results accentuated by intense suffering and life-long lung trouble is indefensible.

There are many gases known which are irrespirable. Some, like carbon dioxide, nitrogen and hydrogen, act merely in the same way as water would do by cutting off the oxygen supply to the lungs, but have no toxic action on the system. Other gases, like carbon monoxide and cyanogen, are powerful poisons, less than 1 per cent. of which in the air will cause death by purely toxic action. Others, again, like sulphur dioxide, chlorine and bromine, may act by producing spasms of the glottis and subsequent asphyxiation.

The use of asphyxiating gas is by no means the simple problem that one might imagine. In the first place, gases differ from other forms of matter in that the molecules of which they consist being free from cohesion are able to intermingle no matter how different may be their weights. This process is known as "diffusion," and unless the gas is very considerably heavier than air it intermingles with the atmosphere so quickly as to prevent it spreading in a poisonous quantity over any considerable area. No gas which was not more than double the weight of air could be used effectively to carry in sufficient quantity to be poisonous at the distances likely to exist between the trenches.

The weight of a gas is represented by its density, that is, how many times it is heavier than hydrogen, the lightest gas known. In the following table are shown the densities of the various gases suspected of having been used or possible to use and the relation of their weight to an equal volume of air :—

	Density	Times heavier than air.
Sulphur dioxide .	32	2·21
Nitrogen tetroxide .	46	3·17
Chlorine. . . .	35·5	2·45
Bromine vapour .	80	5·53
Phosgene . . .	50·6	3·49

By the laws of diffusion, gases intermingle at a rate which is inversely proportional to the square roots of their densities, but air currents or wind enormously increase the rate of admixture, so that with anything like a breeze blowing it would be impossible to use them successfully, whilst the opportunity for "frightfulness" is of course limited by the direction of the wind, so that in Flanders it is only with the wind in the north, or a point or two either side, that effective use could be made of them.

During the past few months the prevailing winds have been in the enemy's favour for considerably more than the normal period, and it is to be hoped that during the next few months, with the prevalent wind from the south or south-west, the opportunity of using these gases will be reduced to a minimum.

A proof of the wonderful power of diffusion in so rapidly causing the mixing of poisonous gases with the air as to render them practically harmless is to be found in the case of carbon monoxide, a gas so poisonous that 1 per cent. proves fatal. All the propellants now in use give enormous volumes of this gas amongst their products of combustion; M.D. cordite gives on firing 50 per cent. of the permanent gases produced as carbon monoxide, or 40 per cent. including the water vapour. One of the 15-in. guns on a super-Dreadnought, with its charge of 400 lb. of cordite, gives about 2,500 cubic feet of this gas each time the big gun is fired, and in every battle fought since the commencement of the war thousands of cubic feet of this gas have been produced, yet not one case of death from poisoning by it can be traced.

The reason of this is that even when cooled down to air temperature it is a trace lighter than air and diffuses so rapidly that enough is never present to prove fatal. The same applies to cyanogen, which also is lighter than air, and these two true poison gases would be useless as factors in a gas attack where the asphyxiant has to travel some little distance.

Taking now the properties of the gases which from their weight it is possible to use, we find that sulphur dioxide is a clear colourless gas, with that intensely penetrating odour which is evolved when sulphur in any of its forms is burnt in air, and which has attracted attention to it from the earliest times. The preparation of the gas is exceedingly simple, as all that is necessary to produce it is to throw finely-powdered sulphur on to an open fire, when combination between the sulphur and oxygen of the air takes place with a blue lambent flame, and the gas pours off with its choking odour. This gas can be reduced to a liquid either by the cold given by a freezing mixture of ice and salt, or by a pressure of three atmospheres, and in the liquid state can be stored in any vessel capable of withstanding pressure, with the result that liquid sulphur dioxide can be bought in siphons of very much the same character as those used for containing soda water.

The power of liquefying a gas by cold, pressure, or a combination of the two, leads to

the possibility of getting into an extremely convenient form large quantities of these asphyxiating gases, all of those enumerated being capable of easy liquefaction; but on again allowing these liquids to assume the gaseous form the trouble arises that heat is absorbed during the change of state, and that in many cases the volatilising liquid has so much heat withdrawn from it as to be frozen into a solid, the flow of gas being stopped or so retarded as to be rendered useless. For this reason the liquid must be discharged either into a vaporising chamber of such size that the sides cannot be cooled down to a point likely to interfere with the escape, or else into a heated coil or tube which will prevent the action of the intense cold.

Chlorine, which is in all probability the gas which has been used to the greatest extent, is of a yellowish green colour. It can be liquefied under a pressure of 6 atmospheres, and has an insupportable odour. When inhaled even in minute quantities it causes choking, and air containing 2 per cent. of it rapidly proves fatal. This gas may be made with the greatest ease by heating a mixture of hydrochloric acid and black oxide of manganese, but it is now produced in large quantities in certain electrolytic processes, from which it can be collected and liquefied, the liquid being stored in lead-lined steel cylinders closed by a valve.

In such a cylinder the gas above the liquid exercises a pressure of at least 90 lb. on the square inch, so that if a cylinder containing it be fitted with a tube which passes down into the liquid and is provided at its exit from the cylinder with a valve, on opening the valve the liquid is blown out in the form of a spray which at atmospheric pressure instantly assumes the gaseous form, and it is in this way that it has been chiefly used. It is reported, however, that where the German trenches are of a more or less permanent character, broad tubes with valves at intervals are laid a few feet in front of the trenches with the openings pointed towards the Allies, the trunk tubes being connected with a gasholder and chlorine plant situated in some sheltered spot some little distance away, so that the mere opening of the valve sets free a flood of gas without the disturbing influence of the cooling effect produced when gas is liberated from a cylinder of compressed liquid. The yellow colour of the gas employed has been a marked feature of all the more serious gas attacks, but it must be remembered that either chlorine or nitrogen tetroxide would give very much this effect, although the latter would be browner in colour.

There are five oxides of nitrogen—nitrogen monoxide, the nitrous oxide of the dentist, or laughing gas as it used to be called. This would never be used as it is not an asphyxiant, and in the diluted condition in which it would reach the trenches would at most give rise to a pleasant feeling of slight intoxication. The fifth oxide of nitrogen—nitrogen pentoxide—is a solid. When the other gaseous oxides of nitrogen are employed for asphyxiation, no matter what the oxide liberated, by the time it had reached the opposite trench it would be nitrogen tetroxide, as nitrogen dioxide and nitrogen trioxide both take up oxygen from the air and become converted into the tetroxide.

Nitrogen tetroxide constitutes the fumes formed during the action of nitric acid on various substances in contact with air, and can be liquefied at temperatures below 26 C. to a liquid varying in colour with the temperature. Most observers from the front insist that this gas has been largely used; but its very general adoption seems doubtful, as nitric acid and the oxides of nitrogen play so important a part in the manufacture of explosives that, in spite of the large quantities of nitric acid made by electrical processes from atmospheric nitrogen, the enemy cannot spare much for this purpose, more especially as chlorine is more effective and can be obtained in any desired quantity without affecting the supply of any other munitions of war.

Only two liquid elements are known, mercury and bromine, and the latter, which is closely akin to chlorine in all its properties, becomes a vapour at atmospheric temperatures, and boils at 59° C. Germany produces practically the whole European supply from traces of magnesium bromide found in the great salt mines at Stassfurth. It is a reddish-brown liquid and gives a vapour of the same colour: its effect upon the system is the same as that of chlorine, and it is supposed to have been used by the Germans in asphyxiating shells, the bursting of which would scatter the liquid bromine and facilitate its conversion into vapour, which, owing to its great weight, would sink to the ground.

It seems possible that sulphur dioxide and chlorine have been the chief asphyxiants used, and many have been the proposals made to fight the use of these gases and render the attacks as little harmful as possible. It would take a series of lectures to consider these, and

it must be remembered that only the simplest measures are available in action. We all know the difficulty of getting men in chemical works to wear respirators, and it is very much the same in action; and, after all is said and done, a cloth well wetted with a solution of washing soda, tied over the mouth and nose when a gas attack is developing, affords excellent protection, whilst the respirators now supplied to the troops have proved effective.

Of the proposals to prevent the gas reaching the trenches, such suggestions as neutralising the gases by ammonia fumes are not practicable, as the air current is setting on to the trenches, or there would be no danger from the enemy's gas, and ammonia gas liberated close in front of our own trenches would probably choke as many as the enemy's gas would have done.

A suggestion, however, that might be both practical and efficient is to have in the trench long iron troughs of about the section of a gutter pipe, which, when a gas attack was developing, could be filled with sawdust saturated with petrol and ignited. Wires attached to each end of the trough and passing over a pulley block fixed to a stump at the first entanglements, would enable the fiercely burning mass to be pulled out ten or twelve feet in front of the trench. The strong up-current caused by the burning mass would throw most of the smoke and poison gas over the trench, and if the troughs were six feet apart, the defenders in the trenches could see through the gaps if any rush of the enemy was starting.

The question of whether England should retaliate in kind is a very open one. The element of surprise is needed to make gas attacks successful, and inasmuch as we have not the remotest chance of surprising the Germans, who expect and are prepared for retaliation, it is far better to keep our hands clean, and fight the same straight fight that has always pulled us through.

A form of poisoning used by the enemy has been the employment of amorphous phosphorus in the shells used partly for the marking of ranges. Amorphous phosphorus is a violet-brown powder, largely used in the composition on safety match-boxes, and differs widely from yellow phosphorus in that it is non-poisonous and inflammable only at a temperature that converts it into the inflammable yellow form. A small cartridge of this included in the 18-pounder shells used for range-marking is converted by the heat of explosion into the ordinary variety, which burns giving a dense white fume of phosphorous pentoxide. This marks the position of the bursting shell by day and earns for these shells the name of "woolly bears," while a flame performs the same function by night. When, however, a fragment of such a shell inflicts a wound, the phosphorus poisons it and complications ensue.

Probably the phase of "frightfulness" that interests the British public as much as any are the bombs dropped by aeroplanes and Zeppelins, of which several distinct varieties are in use.

The British Air Service during this war have used the "Marten Hale bombs," and the execution they have wrought in their numerous and brilliant raids speaks well for the construction of these deadly instruments. They are made in two sizes. The small bomb, fully loaded, weighs 10 lb., and the larger one 20 lb. The latter is the one most in favour with the Air Service, and as many of them as fifteen can be carried on the ordinary aeroplane. The 20-lb. bomb has a high explosive bursting charge of trinitrotoluol, in addition to which there is the primer, consisting of tetryl.

The structural damage done by this large amount of explosive is very great, in addition to which the bomb itself is fragmented into about a thousand pieces, all of which have deadly shrapnel effect.

Amongst the raids two stand out very prominently: firstly, the Düsseldorf event, the official record of which shows that one of the latest Zeppelins was totally destroyed, as also at the same time the huge shed in which it was housed, the machinery hall adjoining and the gas-producing plant, the total damage being estimated at something like £375,000; and secondly, and more recently, the daring exploit of the late Lieutenant Warneford, who, after dropping five bombs and missing his mark, hit the target with the sixth, bringing down one of the huge Zeppelin airships in mid-air, causing its complete destruction and death to every member of the crew, whilst the aviator most miraculously escaped with his own life; but most unhappily met with an accidental death a few days later during a peaceful flight in Paris.

The feature in this design of bomb which has recommended it to our authorities is the extreme safety with which it may be handled, transported, and employed. Normally, the detonator is contained within the tailpiece at such a distance from the main bursting charge that it cannot detonate the latter should the bombs carried by the aviator be hit by anti-aircraft shells; or should he come to the ground

with any violence the greatest result would be a small local fragmentation of the tail part in which the detonator is located. The bomb, to become armed, actually requires to travel a distance of 200 ft. through the air, during which the four small vanes at the top make four and a half revolutions, whereby the detonator is released from a retaining spindle, and is then free immediately on impact or retardation to fly forward into the body of the bursting charge, where it impinges on a firing needle and immediately creates the principal explosion.

These bombs are carried and dropped from the aeroplane in a horizontal position. The three large lower vanes are fixtures, their function being to bring the bomb as quickly as possible into a perpendicular position, and to give it a straight course during its downward flight. These vanes accomplish this remarkably quickly, and although the bomb when launched assumes a pendulum action, it recovers almost directly and becomes perfectly straight in its flight after having travelled about 150 ft.

The bombs are of two types, shrapnel and high explosive: the former carries an explosive charge of 4 lb. 2¼ oz. of trinitrotoluene and 321 steel balls, which, with the fragments of the shell, will often give over a thousand pieces propelled on bursting with enormous force; the latter type, designed for dropping on warships and fortified positions where structural damage is the important effect, carries an explosive charge of 6 lb. 3¼ oz. of T.N.T.

Besides these, incendiary bombs are used which differ somewhat from those used by the enemy, and which, for manifest reasons, cannot be discussed. The incendiary bombs used by the Germans, two forms of which are exhibited, consist of an outer skin wound round with tarred rope, forming a chamber filled with resin, celluloid cuttings, etc., in the centre of which is a charge composed of a mixture of very finely-divided aluminium and oxide of iron. This, when ignited, develops an enormous amount of heat, owing to the combination of the oxygen of the oxide of iron with the aluminium.

This mixture is known in trade as "Thermit"; it was successfully introduced for practical use by Goldschmidt in 1898, and is now largely used for welding rails and other iron and steel structures, and also repairing castings; indeed, for any purpose for which intense local heating is required. In many of these bombs there is a layer of amorphous phosphorus at the base, which, converted into phosphorus vapour by the heat of the thermit reaction, burns with a rush of poisonous flame, igniting everything around, and giving burns which, if not fatal, are poisoned and difficult to heal. It also produces a cloud of fumes of phosphorous pentoxide.

As with the poison gas, the best means of dealing with the danger is the simplest. A few buckets of water applied at once are far better than the most expensive forms of apparatus; and should you have the misfortune to receive one of these Heaven-sent messengers on your premises, the rules laid down by the Fire Prevention Committee are the best that can be devised.

INDUSTRIAL DEVELOPMENT IN THE UNITED PROVINCES.

The report, recently issued, of the committee appointed to inquire into the possibilities of industrial development in the United Provinces—and in particular in those branches of trade hitherto largely monopolised by Germany and Austria—is of an eminently practical character. The committee did not content themselves with pointing out possible lines of development, but, as their report shows, were in some instances able to secure substantial assistance to new or struggling industries. Meetings were held at the principal trading centres of the provinces and questions relating to trade development discussed with those interested. In some cases existing trades were found to be hampered by difficulty in procuring materials, and a good deal of the time of the committee is stated to have been taken up in meeting those requirements. An interesting account is given of the attempts made to foster the production of two chemical substances in considerable request—oxide of cobalt and bichromate of potash—the raw material for which is procurable in India, and the committee believe that with certain concessions from Government in the way of freight an indigenous industry in this connection can be started. The principal industries dealt with were glass bangles, hosiery, wool, lamp-making, dyeing, and calico printing, crushing of oil-seeds, alkalines, and chemicals. These industries already exist in the provinces in various stages of development, and the recommendations made are the result of inquiry and discussion with traders as to the best way in which they can be encouraged. The recommendations necessarily differ with the individual industry. In some cases, as in the glass and lamp trade, the employment of experts was recommended; in others, such as alkalines and chemicals, a removal of certain restrictions and the grant of concessions was suggested. Information was procured in other instances as to the cost of installing the necessary machinery and starting the industry. Throughout it is evident that the creation of the post of

Director of Industries and the appointment of an expert staff and trained instructors of technical schools has greatly facilitated an inquiry of this nature, and rendered it possible to give assistance of a special nature. The report contains an appendix by the assistant chemist deputed to inquire into the procuring of vegetable dyes until a sufficient quantity of artificial dyeing material is again on the market. The same officer is also stated to be working on the improvement of country perfumes. Instructors trained at the technical schools were sent to promising centres to give instruction in the working of hosiery machines; and the superintendent of one of the technical schools was deputed to inquire into the possibilities of developing the lamp trade. It is clear that the Industries Department of the provinces has developed rapidly of recent years, and the local government is much better prepared to further industrial progress. With the staff now at its disposal, sustained interest should take the place of the somewhat spasmodic efforts of the past.

A favourable opportunity has undoubtedly arisen for developing many of the industries, which must still be called minor industries, dealt with in the report. As to the best means of effecting this, opinions are likely to differ. It would appear from the *résumé* given of the views of those consulted that many, who might be in a position to influence public opinion, believed that nothing short of protection would be likely to benefit the nascent industries of the provinces. The arguments for and against this measure have been worn somewhat threadbare and need not be repeated. One point, however, history makes clear, namely, that protection will not necessarily turn a country to the path of industrialism, and, unless it has the effect of introducing keen internal competition, it is accompanied by serious disadvantages.

Something more than the introduction of import duties is required to convert an agricultural into an industrial community. A more practical controversy turns on the amount of direct assistance which can properly be given by Government to the development of the industries of the country. There is little doubt that the experiences of the past few months have accentuated the feeling that in the general interests of the country a larger measure of Government assistance should be given. Too great a dependence on other manufacturing countries for articles which have become practical necessities is not altogether a healthy state of things; and the cessation or diminution of supplies may result in a disorganisation of trade which may more than outweigh the advantages of buying in the cheapest market. England herself, the great protagonist of free trade, has been compelled in one well-known instance to recognise this. The official publication of imports from enemy countries and officially conducted inquiries as to the best means of capturing this trade have not unnaturally given rise to the question as to what assistance Government itself is prepared to give towards effecting this object. Government is being freely invited to declare its policy on the matter, and abundant suggestions are offered as to the form this should take, most of which do not err on the side of moderation. There is, however, one practical limitation to direct Government assistance. Once an industry has been started, a new enterprise can only under ordinary circumstances be aided to the prejudice of those already in existence. This limits Government's interference in a large measure to pioneering industries. Until what may be termed its experimental stage has passed—that is, until its fitness to its environment is proved—there can be little valid objection to such assistance on the grounds of interference with private enterprise or of affording artificial support. The fact that Government has to intervene at all is evidence of a lack of private enterprise in this particular branch. The charge of spoon-feeding can hardly apply to an industry on its trial. The writer of the report has considered it necessary to justify at some length a recommendation for a subvention from the local government to a glass factory, on the ground that the proprietor is spending money on training unskilled labour, which will probably be drawn on by other factories if this one proves a success, and that the said labour is wasting a good deal of valuable material. To gild the pill which may otherwise have an unsavoury look, it is suggested that the grant be made on the condition that the proprietor takes in a certain number of apprentices. But, as Government is coming forward to bear part of the expenses ordinarily borne by the pioneering capitalist, it is not very material which of those expenses is borne, or in what form the aid is given. The main point is whether the industry, if established, is likely to prove of public benefit: if this is the case, and private enterprise is unlikely, owing to initial risks or expenses involved, to establish it unaided, Government would appear justified in coming to its assistance.

An unfavourable comparison is not unfrequently drawn between the rate of progress made in India and in other countries, such as Japan, which started late on their industrial career. It is, however, frequently overlooked that India is a rich country agriculturally, and that indigenous business talent has continued to devote itself mainly to trading in agricultural produce. In inland provinces capital remains concentrated in the hands of the business and banking classes, who, as a body, have shown little tendency to invest it in industrial undertakings. Indian capital is in fact being very slowly diverted into industrial channels. The demand for more rapid progress in developing the industries of the country comes largely from the educated classes, who, apart from patriotic sentiment, are actuated by the very reasonable desire to enlarge the number of careers and professions open to them. To a certain extent the insistence on the necessity of

Government aid is attributable to this cause; for men who have gone through a modern education with a view to entering a profession have usually not the capital necessary for embarking on industrial ventures. But for more rapid progress it is necessary that the capitalist class should show greater readiness to leave the beaten track. Government can pioneer industries; but little purpose will be served unless capital is forthcoming to develop them. The United Provinces have rich agricultural resources. As is pointed out in the report, the production of oil-seeds of various kinds is on an enormous scale; but so far "oil-crushing plants operated by modern machinery can be counted on the fingers of one hand." The area under cane exceeds a million acres; but the provinces still import most of their sugar. In spite of the large area under cotton, most of even the cheap cotton goods come from outside. The utilisation of these resources affords ample opportunities to the capitalist. Lack of requisite training undoubtedly hampers members of the trading and banking classes in turning to industrial pursuits; they are for the most part ignorant of the working of modern machinery and of factory routine, and have little experience in the management of men. But such difficulties, as the Parsee community have shown elsewhere, are not insuperable. Probably in this, as in other matters, we have to look to the initiative of a few far-seeing individuals: in commerce success is apt to breed a number of competitors. For such men there is a wide field awaiting exploitation.—*The Pioneer Mail.*

AN ANCIENT TEUTON COLONY IN ITALY.

While Italy is fighting for the restoration of Italian-speaking tracts on the Trentino, it is curious to note that, on the south side of the frontier, there is a linguistic and ethnic anomaly of a reverse character—a Teuton-speaking colony concentrated on a plateau ensconced amid the Italian mountaineers north of Vicenza and Venice. This curious settlement, according to traditions which not so long ago lingered amongst them, consisted of the descendants of the ancient Cimbri, who were the earliest in the long line of Teutonic invaders of Rome. In 101 B.C. these northerners were broken up in battle by the great Caius Marius and dispersed along the border lands of northern Italy. The Cimbri colony is called I Sette Communi, a few miles from Bassano, a pretty town on that picturesque Alpine stream, the Brenta, which dashes down the rough declivities on its way to the Adriatic. Beyond Bassano lie two towns, Oliero and Valstagna, where the road becomes difficult for wheeled traffic, and mules have to be hired for the further mountain ascent. To an American traveller who explored these parts about half a century ago an Italian guide was here assigned, Count Giovanni Bonnato, who, in spite of his patrician origin (the name is the same as that of the historian of the Sette Communi), was not too proud to undertake the charge of the party, and whose friend, the owner of the mules, was a genuine Cimbrian with a broad sheepish face and a heavy awkward accent of Italian, marking his northern race. It was a lovely morning; the Alps rose crest on crest around, and ahead was the Cimbrian village of Fozza with a white chapel gleaming from the heart of a lofty grove. Under a spreading haw tree, halfway up the mountain, a rest was called for, and here the Count Giovanni and the Cimbrian foregathered. The latter's name in his own tongue was Bruck, which in compliment to his qualities of good-fellowship was converted by the American into Brick. His assurance was that the Capo-gente, or head of the clan at Fozza, could give all information about the Cimbri. From the information supplied to them the travellers essayed to compile a vocabulary of Cimbrian words with their English and German equivalents, and in spite of some very curious dissimilarities the general affinity to the Teutonic roots was very apparent. The village of Fozza boasts about thirty houses and is one of the smallest of the Sette Communi, while the capital, Asiago, contains some thousands of inhabitants and lies more to the west in the direction of Vicenza. The church at Fozza, like the other edifices, was built of stone; and the village at a little distance might look like broken crags of rocks, so well did it consort with the harsh, crude nature about it. Meagre meadow lands, pathetic with tufts of a certain pale blue tearful flower, stretched about the village and southward along the approach from the plains.

At the humble door of the Capo-gente the party entered his dwelling at his wife's invitation and seated themselves near the welcome kitchen fire, though the sunny Lombard plain below was purple with grapes and black with figs. There was a melancholy wail which the peasants iterated ever and anon—"Ah, my lords, is it not a miserable land here?"—and while some eggs and wine were being produced for refreshment the Capo-gente came in. He was a very well-mannered person, but had of course the bashfulness naturally resulting from a lonely life at that altitude where contact with the outside world is infrequent. His fellow-townsmen seemed to regard him with a kind of affectionate deference. He stood till invited to sit down, and presently consented to take some wine with the strangers.

A tradition existed among them, so he said, that their ancestors had fled to those Alps from the Roman general Marius, and had dwelt for a long time in the hollows and caves of the mountains, living and burying their dead in the same secluded places. At what time they had been converted to Christianity he could not tell: they had up to the beginning of the nineteenth century little or no intercourse with the Italians. Formerly they did not intermarry with that race, and it was seldom that any Cimbrian knew its language. But in later times intermarriage had become very frequent, and

Cimbrian was gradually falling into disuse. They still, however, had books of religious instruction in their ancient tongue, and until comparatively lately the services of their church were performed in Cimbrian.

Two of the books were brought forward for inspection, one a catechism for children entitled "Dar Kloane Catechism vor z' Boloseband vortraghet in z' gaprecht von siben Komünen in vier Halghe Gasang, 1842. Padova." The other, a more elaborate work, was called "Johann Andreas Schroeller's Cimbrisches Wörterbuch. Josef Bergman. Vienna. 1855." The author of this book had dwelt for a week in these parts, compiling a dictionary, a copy of which he had sent to the Capo. The total number of the Cimbri was, according to the general belief, nearly ten thousand.

Asiago is generally held to be the chief headquarters, and is now frequented more or less by visitors from Venice as a summer resort. At Oliero the count's services as guide were gratefully dispensed with and a small honorarium bestowed on him. It turned out he was a member of a fairly wealthy family of rank in Venice, and that while he served in the army he had received an allowance from his kinsmen, but that at other times he earned what he could as guide and cicerone to summer tourists and visitors.

More recently a visit was paid to the highland district of the Sette Communi, about twenty years ago, by an American traveller, Mr. W. D. McCrackan, who approached the tract from the west and succeeded in amassing some very interesting data in the course of a lengthened and careful investigation. He points out that visitors from the outside world have always been rare, in spite of the fact that the great route from Verona to Innsbrück over the Brenner runs close under the precipices to the west and east, the favourite road into the Dolomites from Bassano. The traveller remarks that in the land of the Sette Communi the eye roams for many miles east and west over a rolling highland, green and joyous as of the north, spanned by a southern sky. Here and there clusters of houses appear on smooth knolls of ground; men are seen mowing, and rows of women keep time with a rhythm of rakes; herds of cattle graze near and far, the whole forming an idyllic dairy district, surrounded by a woodman's paradise. The houses of the villages and hamlets in the Sette Communi are distinctly un-Italian in appearance. For the most part they are thatched or shingled and peak-roofed, in order to shed the snow in winter, betraying an almost Gothic tendency.

Mr. McCrackan estimated the total population as over 30,000, the greater number being engaged in cattle-breeding, cutting timber, charcoal-burning, and straw-platting. Many of the men go out into the world to peddle pictures of saints and religious books, leaving the women to do the field work.

Most of the documents relating to the period from the tenth to the fifteenth century were lost in a fire at Asiago, which is considered the chief of the villages. Since the fall of the Venetian Republic the remaining archives have for the most part been scattered to the winds, stolen, burned, or used as wrapping paper in meat or sausage shops.

Italian scholars of the seventeenth century, and even later, generally accepted the theory of a Cimbrian origin. An amusing story is told of Frederic IV., King of Denmark and Norway, who paid a visit to Asiago in 1709. It appears that while travelling incognito in Italy as Count of Oldenburg and accompanied by a suite of fifty-four courtiers, he made a stay of a week at Vicenza. On one occasion his courtiers, strolling about the town, were surprised to come upon some men speaking a German dialect. Upon inquiry, the peasants explained that they were from the Sette Communi and were speaking Cimbro. That evening, at dinner, the curious meeting was mentioned in conversation, and next day Frederic, as king of the land which was supposed to be the original seat of the Cimbri, decided to pay a visit to the interesting upland. His cavalcade of Danish and Italian noblemen were received with acclamation by the peasants of Asiago, cries of "Evviva il re dei Cimbri!" resounded on all sides, and local hospitality put its very best foot forward.

Until the seventeenth century the priesthood of the Sette Communi had been recruited almost exclusively from German-speaking native families. But from the moment that the Italian clergy displaced German priests Cimbro was to all intents and purposes superseded. A striking peculiarity of the dialect is the constant change of "v" sounds into "b," *i.e.*, "wir sind" becomes "bir sain." An old man said to Mr. McCrackan at Asiago, "Do you know what we call Verona here? We call it Bern." This recalled the fact that Theodoric the Great, because he sometimes resided at Verona, was known in the German hero romances as Dietrich von Bern. Also may be mentioned the fact that Bern, the capital of Switzerland, was founded by the Dukes of Zaeringen, who had once possessed the Margraviate of Verona, which would seem to indicate that they may have named their new city in memory of the old.

Underneath the big sundial on the wall of the great parish church at Asiago is a Cimbro inscription: "Ich Schbaige, Benne De Lichte Vehlmar, Un Selten Rede, Aber Bahr" ("I am silent when the light fails me, and seldom speak but true").

A proof of the surprising independence of the Sette Communi is afforded by their so-called Nunzi, officials maintained by them in the principal cities of the Venetian Republic to watch over their interests, after the manner of modern consuls. They elected their own judges, and their only obligation was to defend their mountain passes against the foreign foes of Venice. One relic of strong Teutonic influence lies in the common ownership of field and forest. It is administered by the Spettabile Consorzio dei Sette Communi, a body which is the lineal descendant of the Reggenza of Venetian days.

SUGAR INDUSTRY IN THE PHILIPPINES.

The *London and China Telegraph* mentions that, according to a report by Mr. J. F. Boomer, U.S. correspondent at Manila, the first application for Government funds under the provisions of the Sugar Central Act has been received by the Sugar Central Board for the establishment of a "central" at Lagonoy, Ambos Camarines. The request is for $750,000. By the terms of the Act, the applicant must invest an amount equal to that asked from the Government. The Board will visit the section in which it is proposed to establish the central to investigate the conditions.

The farmers of Batangas Province are preparing for an unusually large planting of sugar for the coming year. This increased planting is inspired somewhat by the rising price of sugar and more, perhaps, by the efforts of the representatives of the new large sugar central at Calamba, which is prepared to transport the cane of the farmers from the fields, in Batanga, along the railroad to the central, manufacture it into sugar, and give the farmers as high as 30 per cent. more sugar per ton of cane than they have ever been able to get before. The central company is prepared to lay spurs of track from the railroad to the fields to transport the cane. It is impossible at present to estimate with any degree of certainty the increase in planting that the year will show in the province, but the indications are that it will be very great.

The Bureau of Agriculture is endeavouring to introduce a Hawaiian variety of sugar-cane in the Philippines. Already it has been planted to a considerable extent in Negros. Nurseries for propagating this cane have been started in several parts of the islands, and the planters are taking to it readily. In March, 1914, a quantity of points of the Hawaiian cane from the Government's experiment station at La Carlota, Negros, were taken to Vigan, and set out in ordinary rice land at Bantay, Ilocos Sur. These points were planted on the land of a co-operator of the Bureau of Agriculture, and the cane produced from them was so much superior to the cane theretofore grown in the vicinity that the planters eagerly sought for points for planting on their lands. All the product of the original planting was distributed in the community for seed. It is expected that the Hawaiian variety will soon replace the locally-grown canes in large and important areas of the islands.

NOTES ON BOOKS.

Discoveries and Inventions of the Twentieth Century. By Edward Cressy. London: George Routledge & Sons. 1914.

Though the twentieth century is not yet very old it is responsible for a good many inventions. Last year, in spite of the war, there were 24,820 applications for grants of letters-patent, and the average number of such applications may be taken now as 30,000 per annum. Allow that nine-tenths of these are old, worthless, or trivial, and we still have 3,000 a year, or, say, 40,000 since the century began. An account of all these would fill a big book, and it would take a clever author to compile it. Needless to say, Mr. Cressy has not undertaken such a hopeless task, nor has he attempted the quite practicable, if rather difficult, work of giving us any account of the different directions towards which invention has trended during the last fourteen years, if that particular period was thought convenient, which it certainly would not be.

As a matter of fact, a more accurate title for the book would be, "Some inventions of (shall we say) the end of the nineteenth and the beginning of the twentieth century," though it may be admitted that such a title might fail to attract many readers. As a matter of fact, "it was decided to deal with the characteristic features of development in certain selected fields of enterprise during the last twenty-five years." This has been done satisfactorily enough. The selection has been made with sufficient judgment, and the descriptions written with sufficient accuracy. The subjects include water-power, fuel, steam and other prime movers, generation and use of electricity, steel, workshop appliances, cold storage, liquefaction of gases. agriculture, railways, motor-cars, naval construction, aeroplanes, wireless telegraphy, recent development of photography, with, as a final chapter, "Radium, Electricity, and Matter." This is a diversified, not to say, heterogeneous collection: but those who seek information on the various subjects included will find it; and so far as the limited faculties of the critic qualify him to judge, the information seems correct and to be provided in an intelligible form. The book is very fully illustrated with pictures supplied, for the most part, by owners of the works or makers of the machines or appliances described.

GENERAL NOTES.

German Food Frauds in War.—The *Lancet* draws attention to some novelties in fraudulent foods which are being made in Germany in considerable quantities by manufacturers bent on taking advantage of the desire of relatives at home to send food and delicacies to their friends at the front. One of these is "solid alcohol," advertised as a substitute for alcoholic drinks. The specimens consist of cubes of gelatin, to which brandy and sugar have been added before the mixture has been solidified. The directions are to pour water on these cubes, whereupon one obtains (according to the *Lancet*) "a sweetish fluid, weak in alcohol, and possessing a rather disagreeable flavour of glue." Obviously, with the tendency of alcohol to evaporate swiftly, the longer these cubes are

kept the less is their alcoholic strength. One firm has gone so far as to introduce brandy substitutes and substances of a "peppery" nature to simulate the warmth of a dose of brandy, with the result that complaints have been received from soldiers of painful irritation in the mouth. Coffee and cocoa have also been sold in tablet form at most exorbitant prices, one brand in particular being sold at the rate of 12 marks per pound.

RUBBER PAVING.—Under the sanction of the City authorities, the pavement in front of the offices of the Malay States Information Agency at 88, Cannon Street, has been relaid with rubber tiles, the work being carried out to the order of the Agency by the Leyland and Birmingham Rubber Company, Ltd. These tiles are 12 in. square and half an inch thick, laid on a cement concrete bed, and when walked over give none of the jarring effect experienced from stone pavement. These tiles are manufactured from plantation rubber, and it is hoped one result of the experiment will be to popularise this form of paving, if not for the roadway at least for the foot pavements of our cities.

THE FORESTS OF SIBERIA.—Russia, according to the *Paper-Maker*, will be the world's timber-yard of the future, for no less than two-fifths of the empire is forest land. In European Russia the forests extend over an area of about 345,000,000 acres, of which 214,000,000 acres belong to the State, 88,000,000 acres to individuals, 26,000,000 acres to peasants, and 11,000,000 acres to the Crown, leaving 6,000,000 acres under diverse ownerships. In Asiatic Russia most of the forest land belongs to the State. A conservative estimate puts it at 636,000,000 acres, a low figure when it is remembered that much of the land is as yet unexplored. Thus vast reaches of the timber belt in the Yakutsk Province, bordering on the Arctic, which have never known the foot of civilised man, are roughly reckoned at 90,000,000 acres. The same is true of the vast forest areas in Eastern Siberia. It is safe to say that two-thirds of the timber land in the Russian Empire lies between the Urals and the Pacific. Of the total 636,000,000 acres owned by the State, 239,500,000 acres are being worked directly by the Government, with a yield of about 300,000,000 cubic feet of timber, producing gross receipts of $2,100,000.

THE SOUSLIK OR PRAIRIE MARMOT.—Attention is drawn by a writer in the *Times* Russian Supplement to the damage caused by the *souslik* or prairie marmot, which has long been a scourge to agriculture in the steppe regions of South Russia, especially on the Don, where it annually destroys as much as a quarter of the wheat crop. In 1913 special measures for dealing with the pest were devised at a conference convened by the Cossack Hetman, and all able-bodied members of the population of the province were required to participate under competent direction in the work of extermination. Some idea of the gravity of the danger may be obtained from the fact that in 1914 no fewer than 7,301,982 *sousliks* were destroyed throughout the province by water and upwards of 30 million burrows treated with sulphuretted hydrogen. Since the commencement of the war the majority of the able-bodied men in the province have been called to the colours, but the provincial commission sees no reason why women and children should not be enlisted in this work. It has, therefore, resolved to request the district commissions to compel the local population to deliver at stated periods a fixed number of *sousliks* in proportion to the extent of their holdings, and to recommend the use of sulphuretted hydrogen.

PALM-KERNEL CAKE AND MEAL.—Palm-kernel cake is a very popular cattle food in Germany, Holland, Denmark, and Scandinavia; but it is comparatively unknown in Great Britain. At a time when all foodstuffs are at a premium, it is desirable that British farmers should put aside their traditional conservatism and experiment in new directions. According to the Bulletin of the Imperial Institute, 1,600 tons of palm kernels, as well as 3,000 barrels of palm oil, were recently landed at Hull—the first consignment shipped thither from West Africa. Two products are obtained in crushing palm kernels, oil and cake. The value of the cake as a cattle food is very high, and analyses which have been made show that the cake manufactured in Britain is distinctly superior (owing, probably, to improved methods of crushing) to that made in Germany. Samples of British cake and meal may be seen at the Imperial Institute.

JAPANESE RAILWAY DEVELOPMENT.—H.M. Commercial Attaché at Yokohama reports that of the Imperial Government railways about 175 miles of new sections and about 150 miles of light railways were open to traffic during 1914. The most important sections were 25 miles on the Tokushima line, 23 miles on the Sakata line, and 20 miles each on the Murakami and Gwanyetsu lines. Two of the most interesting events of the year were the completion of the splendid new central station in Tokyo, and the opening of the new Government electric railway between Tokyo and Yokohama. This railway, which runs side by side with the existing steam track, is 19 miles long, and connects the two above-mentioned towns. Between the two termini there are 14 intermediate stations. Unfortunately the railway had only been in operation for a few days at the end of the year when it became necessary for the authorities to discontinue the service. As far as it is possible to ascertain, the whole of the trouble lay with the overhead equipment, which at the time of opening to public service was in an unfinished state, so much so that trial running of the trains was only carried out for about two days.

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FRIDAY, AUGUST 13, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

FOTHERGILL LECTURES ON "MOTOR FUELS."

The Fothergill Lectures on "Motor Fuels," by Professor VIVIAN B. LEWES, F.I.C., F.C.S., have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Royal Society of Arts, John Street, Adelphi, London, W.C.

A full list of the Cantor, Howard, and Fothergill Lectures, which have been published separately, and are still on sale, can also be obtained on application.

PETER LE NEVE FOSTER PRIZE.

Mr. Reginald Le Neve Foster has presented the Society with a donation of £140 for the purpose of founding a prize in commemoration of his father, Mr. Peter Le Neve Foster, who was Secretary of the Society from 1853 to 1879.

The Council have determined to offer the prize for a paper on "Zinc, its Production and Industrial Applications."

The prize will consist of a sum of £10 and the Society's Silver Medal.

The paper for which the prize is awarded will be read at one of the Ordinary Meetings of the Society.

It is expected that some account will be given of the history of the metal, the sources of its supply, its metallurgy, and the various uses to which it has been, or may be, applied.

Intending competitors should send in their papers not later than December 31st, 1915, to the Secretary of the Royal Society of Arts, Adelphi, London, W.C.

The paper must be type-written. It may be sent in under the author's name, or under a motto, accompanied by a sealed envelope enclosing the name, as preferred.

The judges will be appointed by the Council.

The Council reserve the right of withholding the prize or of awarding a smaller prize or smaller prizes, if in the opinion of the judges nothing deserving the full award is sent in.

HENRY TRUEMAN WOOD, *Secretary.*

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

OILS, THEIR PRODUCTION AND MANUFACTURE.

By F. MOLLWO PERKIN, Ph.D., F.I.C., F.C.S., M.Inst.P.T.

Lecture I.—Delivered January 18th, 1915.

The word "oil" embraces a large number of compounds of widely differing characteristics. They all contain the elements carbon and hydrogen, or carbon, hydrogen and oxygen. Thus mineral oils, so called from the fact that they are chiefly obtained by drilling into the ground, consist of carbon and hydrogen, although they may contain impurities such as sulphur and nitrogen compounds, which it is the endeavour of the refiner to remove because they cause the oils to have an unpleasant smell and to become coloured on keeping. The presence of sulphur is particularly objectionable in oils employed for illuminating purposes, because when they are burnt sulphur-dioxide is produced and this becomes oxidised to sulphuric acid, which naturally is very harmful to the decorations in the room in which the oil is burnt.

Most mineral oils are found at great depths below the earth's surface, and are generally under very considerable gas pressure, so that when the drill strikes into the oil reservoir the oil is forced up through the drill-holes and forms spouts or gushers which at times rise to very considerable heights, and often before the drill-hole can be capped lead to very serious losses of oil.

The oil is found in a dip or trough known as a "syncline," which is arched over by a more or less impervious roofing called the "anticline." Owing to volcanic action during the formation or settling of the earth, contractions due to the cooling of the earth's crust occurred. These movements caused flutings in the horizontal strata which frequently produced curved formations. Where the stratum consisted of sand or limestone, impenetrable reservoirs were formed which were arched over by the anticline, and into these reservoirs under certain conditions oil found its way—probably, in fact, was produced *in situ*. The question will naturally be asked, From whence did the oil come? This brings us on to very controversial ground, since there are many theories as to the formation of mineral oil. Most authorities consider that the oil has been produced in the course of ages from organic matter, both animal and vegetable. There are others, however, who attribute its formation to the decomposition of carbides.

Probably at the commencement of the world's history vegetation and also animal life—naturally of a low order—flourished with a rapidity and superabundance which we at present cannot conceive. Vegetation, both land and marine, underwent the annual changes such as we know at present of death and decay, and animals, fish and insects lived and died. These organic materials slowly rotted and became covered up with the calcareous homes of marine organisms and with sand. Pressure thus became gradually exercised, and the internal heat of the earth acting at the same time caused rapid decomposition or distillation under pressure, and under these conditions natural gas and petroleum were formed. The gas and oils gradually collected in the syncline reservoirs, and were retained by the impervious structure of the anticline. The fact of the presence of nitrogenous and sulphur compounds accompanying the crude oil seems to point to a vegetable and animal origin for mineral oils. When we refer to animal life we do not necessarily refer only to low forms such as minute marine organisms, but to all forms of animal life, particularly to whales and other inhabitants of the sea, which are known to contain large quantities of oil. Whale oil, indeed, has a quite different character from mineral oils, but under the joint action of heat, pressure and moisture would probably be split up into hydrocarbons of similar character to mineral oils. Then, again, the decay of the enormous quantities of seaweed was probably a great source. In the warm seas it must have flourished in superabundant luxuriance. Even to-day in our cooler seas the growth is immense. In the Red Sea, for instance, steamers often pass through miles and miles of floating seaweed, which is of such depth and so closely packed as often seriously to decrease their speed. It is reported that in 1890 a steamer took fifty-seven hours to pass through a mass of seaweed in the Red Sea. Rather more than 100 years ago the bulk of the potash salts and of iodine and bromine was manufactured from the derelict seaweed thrown up on the shores. This gift of the ocean is now only used to a small extent, and is allowed to become the sport of the waves. Then, as to terrestrial vegetation—when peat and lignite are distilled, gases, oils and solid paraffin are obtained, and these oils are contaminated to a greater or less extent with impurities similar to those found in mineral oils.

Another theory of oil formation is that metallic carbides account for the formation of hydrocarbon gases and mineral oil, it being suggested that various carbides were produced by the interaction of carbon and metallic oxides under the very high temperature then prevailing. These then came in contact with water or with superheated steam under pressure, and hydrocarbon gases and oils were produced. Under the conditions of high temperature and pressure these gases might become polymerised to form higher hydrocarbons, or there might be a catalytic action between hydrogen and acetylene and other unsaturated hydrocarbons by coming into intimate contact with the presence of nickel, iron or cobalt. Sabatier, indeed, has shown that in the presence of certain metals acetylene and hydrogen can be converted into hydrocarbon oils similar to those obtained from the earth. Thus, for example, by heating acetylene for twenty-eight hours in contact with finely divided nickel, Sabatier obtained 20 cubic centimetres of a liquid oil having the smell of petrol. It should be pointed out, however, that the nickel has to be in a specially active state—a condition which would hardly be found in the nickel as it occurs naturally.

It has been shown by Engler and others that most mineral oils are optically active, and on fractional distillation it is found that, generally speaking, the portions which distil below 200° C. are inactive, but that those between 250° and 300° C. are active, and turn the ray of polarised

light to the right. Thus a Baku oil gave a dextro-rotation of 16°, a Galician 25°. The optical activity of Russian, Galician and German oils is greater than that of those from the United States. I draw attention to the optical activity of mineral oils because it proves that such oils must have a vegetable or animal origin. Oils obtained from carbides or by catalytic action of metals on acetylene, ethylene, etc., would not be optically active.

It is not my intention to go further into the possible derivation of mineral oils, as this was treated in so thorough and masterly a way by Professor Vivian Lewes in his paper on Liquid Fuels, read before the Society this time last year.

Although it is only during the last fifty or sixty years that the production and refining of mineral oils has been a great industry, oil obtained from shallow wells or from exudations on the surface of the earth has been known practically ever since the earth was inhabited. In Genesis it is stated that Noah was commanded to pitch the ark within and without with pitch (Gen. vi. 14). Natural pitch has been produced by the evaporation of the lighter products of petroleum, and by the oxidation and polymerisation of the heavier portions. The slime which the builders of the Tower of Babel (Gen. xi. 3) had for mortar is supposed to have been asphalt or bitumen brought down by a tributary of the Euphrates. Again (Gen. xiv. 10), "The Vale of Siddim was full of slime pits," into which the Kings of Sodom and Gomorrah fell when they fled after being defeated in battle. They apparently did not get out again, because "they that remained fled into the mountain." The word "slime" here mentioned appears in the Vulgate as bitumen. In various other places in the Bible, both in the Old and New Testaments, reference is made to oil or bitumen. Pliny and other writers of his time mention the use of Sicilian oil for illuminating and medicinal purposes. The asphalt or bitumen in the neighbourhood of the Dead Sea was collected and sold into Egypt in the time of Julius Cæsar for embalming bodies. According to ancient records of Japan and China, natural gas and petroleum were employed for illuminating purposes hundreds of years before the Christian Era.

The oil of Baku had apparently been known from the earliest times, and Marco Polo, writing towards the end of the thirteenth century, refers to "a fountain from which oil springs in great abundance." He also mentions that the oil is not good to use with food, but is good to burn, and is used to anoint camels that have the mange. . . . In the olden days, before petroleum was obtained in large quantities, it was frequently used in surgery and medicine and was highly prized. This is a particularly interesting fact, because vaseline and specially prepared petroleum are to-day used as an ointment and for internal purposes in very large quantities. In England inflammable gas was mentioned in 1667. In 1739 Dr. Clayton refers to a pitch which burnt like brandy, and by the flame of which eggs could be boiled. A petroleum from Pitchford was used for burns, rheumatism, etc., under the name of "Bettons oil."

The historical aspect and the gradual building up of a huge industry from small beginnings is always a most interesting and fascinating subject, but it is not possible for me with the time at my disposal and the vast subject to be dealt with to go into minute detail. Suffice it to say, that until about the middle of the last century the mineral-oil industry was of very small dimensions. Then in America, when boring for salt water to be used for the manufacture of salt, source after source of natural gas and petroleum was struck. At first this was a cause of annoyance, and the problem was how to get rid of the oil and obtain the pure salt water. In fact, salt wells were often abandoned because of the infiltration of oil.

Long before the production of petroleum became an American industry it was known to the Indians who dwelt there. Ancient oil wells, sometimes centuries old, have been found in the neighbourhood of Oil Creek in Pennsylvania. Before it was employed as an illuminant, petroleum was used in America as a cure for rheumatism, burns, sprains, etc., and was called "Seneca oil," as it was obtained from the vicinity of Lake Seneca.

Although it was known that oil existed under large areas of land in America, it was not first produced from this source, but from the destructive distillation of shale and coal by Young's process for some considerable time before the natural product, which was afterwards obtained in such prolific quantities, was worked. Indeed, shortly before the development of the mineral-oil industry from fifty to sixty shale refineries were in operation in America. Young's process being a British invention, we may claim that the oil industry originated in Great Britain. It was about 1858 that artesian wells were first drilled with the object of obtaining oil. Shortly

afterwards remarkable results were obtained, and the "oil fever" took possession of the American continent. Huge profits were made and great fortunes lost before the industry settled down to steady production. At first, owing to very crude methods of refining, there was little sale for the oil, and consequently the market was glutted, and enormous quantities of oil were allowed to run waste simply because it did not pay to collect and store it. The following quotation from Sir Boverton Redwood's work on Petroleum and its Products places the early position of the petroleum industry in a nutshell: "In 1859 the total produce, which was wholly obtained from Oil Creek, was 2,000 barrels. In June, 1860, the wells along Oil Creek yielded about 200 barrels daily, and in September about 700. The yield then rapidly increased owing to the discovery of flowing wells, until during the winter and spring of 1861 to 1862 it amounted to about 15,000 barrels daily. The price obtained for the crude oil then fell so low that production was largely arrested, until the production of 1863 was scarcely half that of the beginning of 1862, and that of 1864 still less. In May, 1865, the production had declined to less than 4,000 barrels a day, the Valley of Oil Creek being the only producing locality at the time. It is estimated that some ten million barrels ran to waste in Pennsylvania prior to 1862 owing to the absence of a market."

In the younger days of the industry the problem—always difficult—of capping a powerful gusher was much more formidable than it is now, because as the industry has progressed so the skill and resource of the engineers have also advanced. Even to-day, however, very large quantities of oil frequently run to waste, owing to the difficulty of capping and arresting the flow after oil has been struck.

An oil-field having been discovered, either accidentally or from geological surveys, the geologist prospects and chooses the most favourable position for the engineer to put down a test bore-hole. When an anticlinal structure is located on the surface the choice of position is fairly obvious; but in many cases the position can only be inferred from the examination of a number of data, and the choice becomes a matter of difficulty. The facts that there are external indications of petroleum, such as oil scums, on the surface of water pools, or that bitumen is found in the neighbourhood, or that natural gas escapes, do not necessarily point to supplies of petroleum existing under the earth. Bituminous or asphaltic deposits point to the fact that at one time petroleum existed in the district, because they are produced by the oxidation and polymerisation of the heavier portions of the oil after the lower fractions have evaporated off. They may, however, have been produced by the fracture of an anticline, and all the light oil originally present may have evaporated off, and the remaining heavier portions have been converted into pitch. On the other hand, only a portion of the oil may have thus been lost, and bores may show the presence of hidden reservoirs below. Having located a likely spot for drilling, a shaft 8 to 10 ft. square is sunk through the surface soil. When the bed-rock is reached drilling is commenced. As the drill cuts down the bore-hole is cased by means of a steel tube which is tapered down as the drill reaches deeper and deeper depths. When oil is struck the flow may be gradual and may require pumping, or there may be a gush of gas, sand and oil which will produce a geyser-like fountain, and sometimes drives out the drilling tools before its impetuous flow.

The quality of the oil varies very much: it may be a thick viscid liquid or a more or less limpid fluid. It must not be supposed that a golden yellow or colourless liquid is spouted out. This is very rarely the case. The natural oil is generally dark brown and thick, or may be black in colour, and it is only after refining that burning, lubricating and the various qualities of oil which are found on the market are obtained. A very remarkable oil which is almost colourless has been found at Dingham Well in Canada, but it is obtained only in small quantities. This oil is a thin, limpid, light yellow liquid, and contains a large quantity of oil suitable for light motor-engines. Indeed, it has been used on motor-cars directly as obtained from the well and without previous refining. A sample which I received gave the following fractions at distillation. The specific gravity of original oil was 0·7508 and the initial boiling-point 52° C.

I. Distilled up to 150° C. . 72·8 per cent.
Specific gravity, 0·7300.

II. 150° to 270° C. . . . 24·8 per cent.
Speci c gravity, 0·7985.

Above 270° C. a semi-solid residue of 2·7 per cent.

It is possible that on drilling deeper a heavier oil will be obtained from which this oil has been distilled by internal heat. One may suppose that the lighter fractions of a heavier oil have been distilled off, and have condensed and

collected into a pocket, which is the well at present struck.

In some districts oil is found comparatively near the surface. In others, bore-holes of great depths have to be sunk before oil is reached. Thus in Baku, where wells were first sunk, oil was encountered in some parts at a depth of about 150 ft. Now that the fields have become more or less exhausted, much deeper drilling is necessary. In Galicia oil is not generally tapped until a depth of 3,000 to 4,000 ft. is attained. The greater the depth, naturally the greater the initial expense incurred before the wells are producing. The original Burma wells which were dug by the natives were also comparatively shallow. In some districts oil can be ladled out of quite shallow holes. The object of casing the drill-hole is to prevent the wall of the hole from caving in and to keep out the water. If a well is about 2,000 ft. deep, the diameter of the casing at the top is usually at least three times the diameter of the casing at the bottom. The oil having been struck is led by means of pipes into reservoirs, which are often in the first place formed in natural hollows by damming. Here the oil separates from sand and water and becomes in a condition to be taken to the refinery.

The crude oil consists of a mixture of a large number of hydrocarbons. The proportions of heavy and light oils vary very much and are dependent upon the source of the petroleum. The lighter hydrocarbons have a lower boiling-point and a lower specific gravity than the heavier; therefore they can be more or less readily separated by means of fractional distillation. As, however, the boiling-points of the various compounds lie very close together, the pure individual hydrocarbon is never obtained commercially. By very careful and laborious fractionisation in the laboratory a large number of pure hydrocarbons have as a matter of fact been isolated, but there would be no object or advantage in doing this commercially.

The different classes of hydrocarbons met with may be briefly described under three heads: Methane, or paraffin hydrocarbons, which are the most stable of all, and the most difficult to oxidise or to act on chemically; the Ethylene, or olefiant hydrocarbons, which are more readily acted upon by chemical agencies and more readily oxidised; and the Naphthenes, which may be looked upon as hydrogenated benzenes, and are also very stable and difficult to oxidise or to decompose. Thus the methane and naphthene hydrocarbons are hardly attacked by strong sulphuric acid, but the ethylene hydrocarbons dissolve in the concentrated acid. The lower members of the methane and ethylene series are gases, and particularly gases of the methane series are contained in the gases which accompany most naturally occurring oil. In the following tables the boiling-point and specific gravity of a few members of the methane and ethylene groups are given:—

METHANE SERIES.

	Formula.	Specific Gravity.	Boiling-point.	Melting-point.
Methane	CH_4	0·415	−164° C.	..
Butane	C_4H_{10}	0·600	+ 1° C.	..
Hexane	C_6H_{14}	0·6603	+ 69° C.	.
Heptane	C_7H_{16}	0·683	+ 98·3° C.	..
Tetradecane	$C_{14}H_{30}$	0·775	+252° C.	+4° C.
Octadecane	$C_{18}H_{38}$	0·777	+317° C.	+28° C.

ETHYLENE SERIES.

	Formula.	Specific Gravity.	Boiling-point.	Melting-point.
Ethylene	C_2H_4	0·6095	−102° C.	..
Butylene	C_4H_8	666	− 5° C.	..
Hexylene	C_6H_{12}	0·683	69° C.	..
Heptylene	C_7H_{14}	0·703	123° C.	.
Decylene	$C_{10}H_{20}$	0·7512	172° C.	..
Octadecylene	$C_{18}H_{36}$	0·791	*179° C.	+18° C.

* Boiling-point at a pressure of 15 mm.

The difference between the methane series and the ethylene series is that corresponding members of the latter series contain two hydrogen atoms less than the members of the methane series, and are, therefore, said to be unsaturated. In the methane series all the affinities of the carbon atom are satisfied by

hydrogen. It is, therefore, only possible to act upon it chemically by replacing one or more of the hydrogen atoms by some other substance. It is, however, very difficult to turn out the atoms of hydrogen and substitute some other element. Therefore hydrocarbons of the methane series are extremely stable. On the other hand, owing to the hydrocarbons of the ethylene series being unsaturated, they are much more readily attacked by chemical agents, and are, therefore, more readily oxidised Take, for example, the hydrocarbons butane C_4H_{10} and butylene C_4H_8, which may be written more fully $CH_3.CH_2.CH_2.CH_3$ and $CH_3.CH_2.CH=CH_2$. We notice that butylene, which belongs to the ethylene series, contains two hydrogen atoms less than butane, and that there it has a double union or bond. It is at this point that butylene is most readily attacked, and it is the presence of this double union which makes it more readily oxidised and chemically active than butane. Thus on fractionisation the methane or paraffin hydrocarbons can be distilled without decomposition, but with the ethylenes decomposition and splitting commence with the hydrocarbons above $C_{12}H_{24}$. To prevent this they are often distilled in a vacuum.

The naphthenes belong to another series of hydrocarbons, in which, instead of the carbon atoms being joined together in the form of a chain, they are connected in a ring formation, thus:—

Naphthene Series.	*Methane Series.*
$\begin{array}{l} CH_2 \diagdown \\ \vert \quad\quad > CH_2 \\ CH_2 \diagup \end{array}$	$CH_3.CH_2.CH_3$
Cyclopropane. (C_3H_6)	*Propane.* C_3H_8
$\begin{array}{l} CH_2.CH_2 \diagdown \\ \vert \quad\quad\quad\quad > CH_2 \\ CH_2.CH_2 \diagup \end{array}$	$CH_3.CH_2.CH_2.CH_2.CH_3$
Cyclopentane. (C_5H_{10})	*Pentane.* (C_5H_{12})
$\begin{array}{l} CH_2.CH_2.CH_2 \\ \vert \quad\quad\quad\quad\quad \vert \\ CH_2.CH_2.CH_2 \end{array}$	$CH_3.CH_2.CH_2.CH_2.CH_2.CH_3$
Cyclohexane. (C_6H_{12})	*Hexane.* (C_6H_{14})

The following are the boiling-points and specific gravities of a few of the naphthenes:—

Substance.	Boiling-point.	Specific Gravity.
Cyclopentane C_5H_{10}	51° C.	0·7506
Cyclohexane C_6H_{12}	81° C.	0·7788
Cycloheptane C_7H_{14}	117·5° C.	0·8253
Nononaphthene C_9H_{18}	136° C.	0·7808

The naphthenes are much more stable than the ethylenes—in fact, almost as stable as the methanes. We generally use the terms paraffins, olefines, and naphthenes for these three classes of compounds. The proportion of these different series of hydrocarbons in the oils depends upon the locality from which the oils are obtained.

Besides the hydrocarbons mentioned, there are sometimes also small quantities of aromatic hydrocarbons, such as benzol and its homologues, and traces of terpene-like bodies. There are also present oxygenated bodies or phenols and nitrogen compounds, the latter having generally a very unpleasant odour. These bodies are removed in the process of refining. Sulphur bodies are usually present, and are frequently very objectionable; but, unfortunately, they are difficult to eliminate, and, if present in large quantities, add to the expense of refining.

Galician and Caucasian petroleum contains large quantities of naphthenes, whereas American oil consists largely of paraffins. Shale oil, on the other hand, and oils obtained by low temperature carbonisation of coals, peat, etc., contain a large quantity of olefiant oils.

It will be noticed that the specific gravities of the hydrocarbons of the ethylene and naphthene series are considerably higher than those of the methane series. This is due to the fact that the hydrocarbons, which are richer in carbon and contain less hydrogen, always have a higher specific gravity. On the other hand, the melting-points of the saturated hydrocarbons are higher than those of the unsaturated series, as, for example, octadecane melting-point, 28° C., and octadecylene melting-point, 18° C.

Refining the Crude Oil.

As already mentioned, most natural oils require to be refined before they can be used in commerce. The first process of refining is one of distillation. The oils are run into large cast-iron stills which are first gently and then strongly heated. At low temperatures low boiling oils of low specific gravity and flash-point distil over, and as the temperature is increased intermediate oils and, finally, lubricating oils and paraffin wax are obtained.

The fractions may be roughly divided into—

1. Petrol.
2. Solvent oils.
3. Illuminating oils for lamps.
4. Solar oils or gas oils.
5. Lubricating oils.
6. Paraffin wax (generally in the first place mixed with lubricating oil).

In the retort asphalt remains, or, if the distillation is pressed further, coke or retort carbon (which, as it contains very little ash, is valuable for the manufacture of electric-light carbons and electrodes).

As all natural oil contains certain quantities of water emulsified with it, great care has to be taken at the commencement of the distillation to prevent frothing, which would cause the oil to foam over into the condensers. At the beginning of the distillation a mixture of light oil and water passes into the receiver, and until the water has all been driven off the temperature of the oil in the retort will not rise much above 100° C.

The distillation is usually conducted in two stages, the first consisting in the removal of the more volatile fractions, and the second distillation, generally conducted in separate retorts, to produce lubricating oils and paraffin. In Russia a continuous process of distillation is largely practised, the crude oil being supplied to the still as rapidly as the oil is distilled off. The original American stills were completely bricked in; but after it was found that larger yields of light fractions could be obtained by allowing the condensed oil to drop back into the hot oil in the still, the tops have been left uncovered. This allows a portion of the oil to condense on the dome of the still and to drop back; it is thus "cracked" into lighter fractions. Cracking and cracking processes will be referred to later. As a matter of fact, whether or not it is advisable to crack an oil depends upon the class of oil which is most required by the market. If, as was the case before incandescent gas and electric light came into such general use, oil for illuminating purposes was required, then cracking produced a much higher proportion of this product. Kerosene was then the most valuable product. To-day it is not so. Motor spirit, fuel oil and lubricating oils are the most sought after products. At one time petrol had hardly any market value; it had to be eliminated from the kerosene, and we were constantly reminded that this was not efficiently done by the cry of the "deadly low flash." The producers naturally preferred to leave it in because the bulk of kerosene was increased and they got rid of a spirit which otherwise was a drug on the market. The chief use in those days of the very low boiling fractions was for so-called dry-cleaning purposes and as solvents, for which objects the demand was naturally limited.

It is difficult to give exact figures of the fractions, as they vary with the class of oil dealt with. Motor spirit is usually the fraction up to 150° C., but it is sometimes carried up to 160° C. Kerosene generally distils between 150° C. and 240° C.; Fuel oil from 170° to 300°; but if there be much paraffin wax present it may not be possible to take it to so high a temperature. Lubricating oils generally require to be distilled in a vacuum to prevent cracking.

After distillation the several fractions are treated with sulphuric acid and caustic soda to remove the impurities, and sometimes they are subsequently redistilled. When a large quantity of phenolic bodies is present, the first treatment is with caustic soda to remove them. The oil is then washed with water, about ½ per cent. of strong sulphuric acid is added, and the oil and acid thoroughly agitated. The mixture is then allowed to settle, when the acid falls to the bottom and can be run off. A second portion of acid is then added, the proportion depending upon the quality of the oil which is being refined. The first portion of acid acts chiefly as a dehydrating agent, so that when the second portion is added the oil is dry and the acid is not diluted. With the heavier oils of high boiling-point the agitation and mixing of the acid and oil are done by means of compressed air. With light oils such as petrol this would cause loss of some of the lower fractions; therefore the mixture is agitated mechanically or washed by a gravitation method.

There is always some danger of the emulsifying of the oils with the alkali and water washings, particularly when dealing with heavy lubricating oils. Consequently, great care has to be exercised in conducting the agitation. Generally separation takes place better if the oil is kept warm, which may be done either by means of steam coils placed within the agitator or by having the agitator jacketed. As soon as the bulk of the water has separated it is run off, and the oil is transported to shallow jacketed pans, where it is heated to the boiling-point of water until the frothing ceases, indicating that the water has all been driven off.

In order to get over the emulsifying difficulty and to have a continuous process, agitation is sometimes dispensed with. The oil is caused to flow through successive vessels which contain respectively sulphuric acid, soda lye, and water, and finally through a mixture of sawdust and salt in order to dry it. This process is used for treating the lighter fractions. Closed iron vessels are employed which are half filled with the reagent, and arranged in steps so that the

spirit will pass through by gravity. The spirit placed at a higher level is run by means of a perforated tube to the bottom of the first vessel, which contains sulphuric acid, as do the two succeeding vessels. The spirit, being much lighter than the acid, passes through it and rises to the top. It is then run through the succeeding vessels of acid, lye, and water, and finally through the filter. The methods of refining vary to a certain extent according to what products are chiefly required. Thus, when illuminating oils such as kerosene, having a specific gravity of 0·800 to 0·810, were fetching good prices, the American process was to endeavour to obtain as high a yield as possible of this fraction. As already pointed out, when a heavy oil is distilled more or less decomposition, technically called cracking, takes place, and oils of lower gravity and boiling-point are obtained. This fact was accidentally discovered in America in 1861. The man in charge

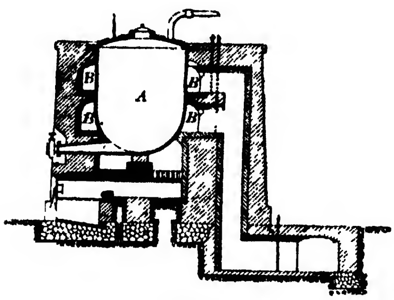

FIG. 1.

of a still had occasion to leave, but expected to return within an hour. He was detained, however, and did not return for some hours. Before leaving he had made up a good fire under the still; the oil, which was distilling over when the man left, had a gravity of 0·809—that is, was an ordinary kerosene oil. On returning about four hours later he noticed that a thinner oil was distilling with a gravity of 0·786. This, of course, was difficult to understand, as it was against preconceived ideas and practice. The manager of the works was called, and by this time a still thinner oil was distilling, having a gravity of 0·769. On consideration, and then by experiment, the manager found that the oil had been condensing on the top of the retort and falling back into the hot oil in the still. This caused a breaking down of the molecules and lighter oils were obtained. At this time illuminating oils were the most valuable products obtained from mineral oils. As a consequence of this accidental discovery, the retorts were so altered that about 20 per cent. more kerosene oil was obtained than previously. Fig. 1 shows the form of still used for the purpose The retort *A* is of cast-iron, and only the lower part is directly heated. The upper parts are kept superheated (that is, above the distillation temperature) by the flues *B.B.*, *B.B.* The upper part of the retort is uncovered and exposed to the air, so that part of the oil will condense there, and fall back into the strongly heated oil in the retort and down the heated upper portions. In such a retort the oil is distilled until a pitch or asphalt is produced which can be readily run off while hot by the outlet *C*. It should be mentioned that the oil which is obtained by cracking is not of such a high quality as oil obtained in the fractions which are produced before the cracking commences, and, therefore, the uncracked and cracked oils are often collected separately.

At the present day kerosene is not so much required, and is to a certain extent a drug on the market. The most valuable, or at any rate most required, oils are motor spirit, fuel oils and lubricating oils. Motor spirit and lubricating oils require to be highly refined, but with fuel oil this is not necessary. The methods of refining motor spirit and lubricating oils have already been referred to—that is, by treatment with acid and alkali, and, if necessary, subsequent distillation. When, however, the oils contain large quantities of sulphur, the refining is more difficult. Sulphur is objectionable in that it gives the oils a bad smell and colour, and if the oils are to be used for internal-combustion engines a very unpleasant exhaust is obtained.

Canadian oils in particular contain considerable quantities of sulphur compounds, and at one time for this reason they had very little sale. Owing to the unpleasant smell imparted to the oil by the sulphur compounds the oil was known in Canada as "skunk." Special methods of purifying it had, therefore, to be devised.

The oil was first treated with sulphuric acid which, after agitation and settlement, was drawn off. A second treatment with acid followed. After the residue had been drawn off the oil was washed, without agitation, with water. The water was drawn off and caustic soda added, after which the mixture was agitated for about a quarter of an hour. The mixture was allowed to settle and the alkaline layer drawn off. Then the oil was agitated with a further caustic soda in which litharge had been dissolved. The sodium lead salt reacted on a portion of the sulphur compounds,

lead sulphate was produced, and the oil was completely deodorised. It was now necessary to remove the excess of lead, and for this purpose flowers of sulphur was added, the mixture agitated and allowed to settle overnight. Such a process is much more complicated than the ordinary methods of refining, and is not now used. Many other processes have been suggested, such as, for example, (*a*) distilling the oil over lead oxide, and subsequently refining it with sulphuric acid; (*b*) passing the vapours of the oil over heated iron or copper; (*c*) treating the oil with a solution of copper sulphate, caustic soda and common salt, and then digesting it with flowers of sulphur, this doing away with the sulphuric-acid treatment.

It should be mentioned that most oils after being refined are bleached by running them into shallow pans and exposing them to the action of the light. This, of course, could not be done with petrol oils owing to their too great volatility.

For the purification of illuminating oils a new process has recently been introduced by Dr. Edeleanu, in which liquid sulphur dioxide is used in place of sulphuric acid. In illuminating oils, if a clear white flame is to be obtained, the preponderance of the hydrocarbons of the paraffin and naphthene series is of importance. If there are larger quantities of unsaturated hydrocarbons in the oils, the illuminating qualities are reduced. It is, indeed, possible to construct lamps which will give a bright white flame with unsaturated oils; but this would mean that the consumer would have to be in a position to dictate as to the quality of the oil which he was purchasing. Oils from Pennsylvania are most generally used, and these consist in the main of saturated hydrocarbons of the paraffin series. Russian burning oils contain chiefly saturated hydrocarbons, also of the paraffin and naphthene series. Other oils which contain considerable quantities of unsaturated hydrocarbons can be treated with sulphuric acid until the bulk of the unsaturated hydrocarbons is removed; but the loss is great, and the dissolved, or rather decomposed, hydrocarbons cannot be recovered. By the process of Dr. Edeleanu the unsaturated hydrocarbons are indeed dissolved out, but they are not decomposed and lost. Whilst, therefore, the saturated oils are freed from the unsaturated and can be used for illuminating purposes, the unsaturated hydrocarbons can be recovered and employed for other purposes.

The principle of the method is based on the property of liquid sulphur dioxide to dissolve unsaturated and aromatic hydrocarbons rich in carbon more readily than the saturated hydrocarbons of the paraffin and naphthene series. When a petroleum distillate is mixed with liquid sulphur dioxide at a low temperature, two layers are formed. The lower layer consists mainly of the unsaturated hydrocarbons dissolved in liquid sulphur dioxide, while the upper layers contain chiefly saturated hydrocarbons with a small quantity of sulphur dioxide. In practice the best results are obtained at a temperature of 5° C. to 10° C. In order to obtain the most satisfactory results the solvent should not be used in one portion, but in several small portions in succession. In fact, in all cases of extraction better results are obtained by adding the solvent in successive small quantities, rather than all at once.

Unsaturated hydrocarbons have a higher specific gravity than saturated hydrocarbons because they contain a higher proportion of carbon. It naturally follows, therefore, that the specific gravity of oils which have been treated with liquid sulphur dioxide is reduced. This is shown by the following three examples:—

	Original Gravity.	After Treatment.
Tustanowice oil . .	0·8150	0·8040
Mexico	0·8014	0·7901
Peru	0·8042	0·7890

The small amount of sulphur dioxide retained in the upper layer is readily got rid of by evaporation, and the last traces by washing with water.

Oils treated by the sulphur-dioxide method have a lower specific gravity, a lower sulphur content, and a slightly higher flash-point, as shown in the table given on p. 846.

The illuminating power of the oils is increased and the hourly consumption decreased. The specific gravity of the extract, which consists mainly of unsaturated hydrocarbons and aromatic bodies, is considerably higher. The products so obtained have not much value for motor or illuminating purposes, but are said to make a valuable turpentine substitute for the paint and varnish industry because the oil has good drying properties and may be used as a substitute for gums, resins, etc.

Plant dealing with 62 tons per day has already been installed, and Engler considers that it is an important innovation in that it allows the manufacture of illuminating oils from materials which were hitherto considered unrefinable.

Crude Oil from	I. Properties.	II. Crude Distillate.	III. Oil by Usual Methods.	IV. New Method.	V. Lower Layer or Extract.
Bushtenari . .	Specific gravity	0·8200	0·8195	0·8028	0·8650
	Flash-point	80·6°	83·5°	84·5	—
	Sulphur	0·052%	0·016	0·008	0·042
Tustanowice .	Specific gravity	0·8090	0·8084	0·7970	0·8875
	Flash-point	95°	95°	96°	—
Mexico . . .	Specific gravity	0·8030	0·8025	0·7926	0·8640
	Flash-point	78·8°	79·7°	80·6	—
	Sulphur	—	0·404	0·164	1·10
Peru	Specific gravity	0·8175	0·8165	0·8122	0·8630
	Flash-point	73·4	74·3	0·75	

The working of the process technically is illustrated by the following scheme (Fig. 2):—

The crude distillate is passed through the filter (1), where it is filtered through a mixture of salt and calcium chloride to free it from moisture. The dry oil then passes into the tank (2), from where it is pumped into the cooler (3), passing on its way a heat-extractor (4). The liquid sulphur dioxide is passed from the tank (*a*) into the cooler (*b*) and through the pre-heater (*c*). The oil is passed from the cooler into the agitator (5), where the sulphur dioxide is added in the form of a fine spray. Mechanical agitation is thus not required. Two layers are formed, the upper one of kerosene and the lower the unsaturated hydrocarbons and sulphur dioxide. When sufficient sulphur dioxide has been added, which is done in several portions, the lower layer is removed, passed through the heat-extractor (4) and into the evaporator (6). When the whole of the lower layer has been removed, a valve is reversed and the upper layer of kerosene is passed into an evaporator (*d*), passing on its way the heat-extractor (*c*). The sulphur dioxide is removed in the two evaporators (6) and (*d*), the small quantities which remain being easily washed out with water. The bulk of the sulphur dioxide, about 90 per cent., is recovered by passing into a condenser, where it is liquefied and passed back into the tank. The remainder of the sulphur dioxide which is being exhausted from the evaporators (6) and (*d*) is passed through the compressors (*f*) into the condenser (*e*), where it is liquefied and passed into the tank. The Pennsylvania oils are chiefly worked for illuminating

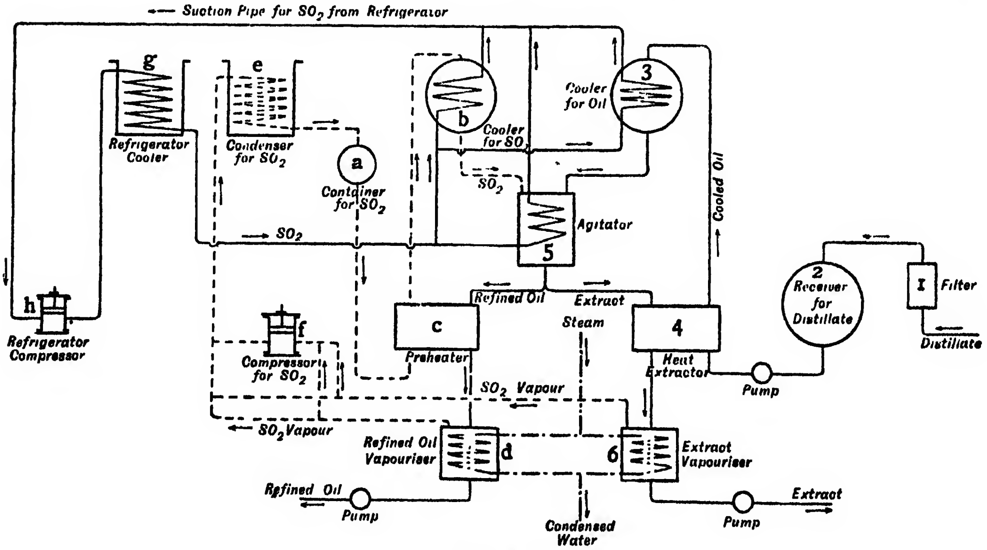

FIG. 2.

oils, whereas the Caucasian yield a very valuable lubricating oil. As already mentioned, lubricating oils are refined with sulphuric acid and alkali in a similar manner to the lower fractions, after which they are placed in clarifying vessels. Sometimes, however, it is found difficult to remove the colour by ordinary methods of refining, and they are filtered through bone-black or the charcoal residue obtained from the manufacture of potassium ferrocyanide, which is a particularly active form of carbon. *Vaseline*, a non-crystalline semi-solid oil, is obtained from the higher fractions of American oils, and was first placed on the market by the Cheeseborough Manufacturing Company. Certain crude petroleums are distilled in vacuum in order to minimise dissociation, and the semi-solid products filtered hot through granular animal charcoal or Fuller's earth. The first runnings are colourless and are collected separately. Certain forms of infusorial earth are also sometimes used. Vaseline can also be obtained from Russian and Galician oils.

Vaseline is largely employed in pharmacy for making ointments. It often has antiseptics mixed with it, such as salicylic acid, boric acid, camphor, etc. A product put on the market by the Cheeseborough Manufacturing Company, which is composed of vaseline and camphor, is known as camphor ice. Vaseline is also employed as a lubricant, and for smearing on metal articles to prevent corrosion.

Specially purified odourless and tasteless petroleum is now largely used medicinally, and is sold under the name of *Paraffinum Liquidum*. This product is best prepared from Galician lubricating oil or Russian distillate having a specific gravity of 0·890 to 0·905, or a mixture of vaseline oil and lubricating oil. The oils are first treated with ordinary sulphuric acid to remove any moisture and then with fuming acid. After this treatment the tarry residue is run off, and the oil again treated with ordinary sulphuric acid to remove sulphonated bodies which may be dissolved in the oil. The residual oil is then washed with water and alkali, and may finally be treated with alcohol which is evaporated off, and the oil filtered through charcoal or Fuller's earth. The final specific gravity of the oil is 0·880 to 0·885. The process is difficult, owing to the emulsifying of the very viscous oil with the water and alkali solution. It is interesting to note that although the specific gravity is decreased by the treatment, the viscosity increases. American oils are much more difficult to refine in this manner owing, it is said, to the larger amount of sulphur contained in them; but I understand that white petroleum has now been produced successfully from certain oils of American origin. This is a very important matter, because, while the war lasts, it is impossible to obtain oil from the continent of Europe. My own opinion is that Russian oils are more readily purified in this manner owing to their high content of naphthenes.

It frequently happens that the higher fractions of petroleum are semi-solid owing to being a mixture of lubricating oil and crystalline paraffin. Amorphous semi-solid vaseline is a good lubricant, but the admixture of crystalline solid paraffin reduces the viscosity of the oil, and must, therefore, be removed if the oil is to be used as a lubricant.

In the United States the residue remaining after the distillation of the kerosene fraction, which has a specific gravity of about 0·940, is distilled in a current of superheated steam from large cylindrical steel stills. The steam prevents decomposition and cracking of the hydrocarbons, which would decrease the yield of solid paraffin and lower the viscosity of the lubricating oil. The water surrounding the cooling pipes is kept warm to prevent the solidification of the paraffin wax.

The first fraction which passes over has a specific gravity of about 0·834, and is frequently re-distilled with a second charge. The residue is generally distilled in two fractions, the proportions of which vary with the description of the oil required. The specific gravity of the second fraction usually varies between 0·860 and 0·870. The specific gravity of the final fraction varies between 0·910 and 0·922. Each fraction may be divided into several further fractions to produce different classes of lubricating oils.

The oil is purified in the usual manner with sulphuric acid and caustic soda, the temperature being kept sufficiently high to prevent solidification of the paraffin wax. The purified oil is then passed through the cooled pipes. As it cools the solid paraffin separates out, a semi-solid mass being obtained. This semi-solid product is then passed through filter presses which remove the bulk of the oil. The cake is then subjected to hydraulic pressure, which removes a further quantity of oil, and then "sweated." This is a process of fractional fusion which removes the lower melting wax and any remaining oil.

The paraffin cake so obtained still has a

yellowish tint, and requires to be further refined in order to make it perfectly white. The final refining consists in mixing it with charcoal in a steam-jacketed pan. The charcoal is intimately incorporated with the melted paraffin by means of a current of hot air, after which the mixture is filtered, the charcoal remaining behind and the decolourised paraffin passing through the filter. The paraffin is then allowed to cool, when a solid white product is obtained.

The mineral-oil industry is one of the largest industries of the world—perhaps the largest individual industry. The total world's production to-day is about 50,000,000 tons per annum, and prospectors are feverishly engaged in trying to find more. The evolution of the industry has been a gradual one. When the first gusher was struck in 1859 the chief use for the oil was as an illuminant in place of the vegetable and animal oils previously employed. Then by degrees it was found that the higher fractions contained valuable lubricating oils and paraffin wax, which is the basis of most of the candles employed at the present time. Pure paraffin wax is not satisfactory for the candle industry, as it is too soft and the candles are apt to bend. Small quantities of stearine are, therefore, usually added to it. In connection with the candle industry, it is interesting to note that when pure paraffin wax is used it is difficult to colour the candles, as most dyes do not colour paraffin. By employing a mixture of stearine or other animal or vegetable wax the dye is readily taken up.

Again a change has come over the mineral-oil industry. With the introduction of the internal-combustion engine for motor-cars, stationary motor-engines, aeroplanes, etc., the requirements of the lower fractions which constitute petrol have enormously increased. Twenty years ago the lower fractions were a drug on the market. To-day kerosene is the drug, and the lower fractions and the fractions above kerosene, which are used for fuel oil for heavier engines of the Diesel and semi-Diesel type and as a fuel for direct firing, are what is required. The requirements for lubricating oil are always increasing.

THE TRADE OF FOOCHOW.

Some interesting information is given by H.M. Consul at Foochow on the trade of that district in 1914.

That the hostilities in Europe have had a detrimental effect on the foreign import trade of Foochow is obvious from the returns for 1914, which show a falling-off under almost every heading. The decline is due to the rise in the price of all foreign articles, the silver cost of which, as a result mainly of the fall in exchange, has risen at least 10 per cent. since August, while certain articles supplied by Germany and other European countries have more than doubled in cost. Business was also affected by the stoppage during August and part of September of the foreign export trade, which, while it lasted, caused great anxiety to the mercantile community and restricted all commercial operations.

Capture of Enemy Trade.

The chief imports into the Foochow district of German origin have been aniline dyes, artificial indigo, needles, Berlin wool, hosiery, blankets, silk bordering for Chinese dresses, lampware, and umbrella frames, while Belgium has supplied glass, and Austria-Hungary enamelled ware. Though in no single item is the trade of any great importance, yet its aggregate value is considerable. Since the war commenced all the articles mentioned have risen greatly in price, but so far it is only in aniline dyes, indigo, and glass that the scarcity has been seriously felt. Dyes and indigo in particular have become indispensable to the Chinese, and, unfortunately for them, Germany is the only present source of supply. For the trade in umbrella frames and that in enamelled ware, Japan is making a strong bid, and will, no doubt, capture both, and probably the trades in lampware and hosiery also—in all of which articles cheapness is more essential than quality. There seems no reason why British firms should not supply the needles and blankets hitherto imported from Germany, or the better qualities of window and mirror glass formerly supplied by Belgium.

There were heavy increases in 1914 in the imports of American and Sumatra oil and a decline in imports of Borneo oil; but the most interesting feature of the year in connection with the oil trade is the appearance on the local market for the first time of Japanese oil. Judging from the number of complaints made to the Foochow Consulate, this oil, which is mostly of very poor quality and correspondingly cheap, is purchased by Chinese dealers, either to be surreptitiously mixed with the more expensive American and Sumatra oils or to be sold as such to ignorant customers, who are easily deceived by the likeness in the labels.

Except in such articles as kerosene and other oils there is little or no direct import trade between Foochow and foreign countries, local dealers preferring to purchase their stocks of other goods in Hong-Kong and Shanghai.

Cotton Goods.

In the report on the trade of the port for 1913 the total value of the native cotton goods imported into Foochow that year was placed at 1,319,807 taels* and that of the foreign cottons at 1,419,106

* The average value of the Haikwan tael in 1913 was 3s. 0¼d., and in 1914 2s. 8¾d.

taels. It was also pointed out that, in view of the increasing supply of cotton yarn and cloth from the Shanghai mills, it seemed likely that the small percentage in favour of the foreign products would soon disappear. The rise in 1914 in the cost of foreign goods has brought about this change rather sooner than might have been expected. Whereas the import of foreign cottons in 1914 has declined in value to 1,218,474 taels, that of native cottons, in spite of a lower valuation by the Customs, has increased to 1,413,739 taels. The decrease in the foreign import is mainly accounted for by smaller purchases of Indian yarn, with which, at its present price, the Shanghai article is able, it would seem, to compete on equal terms. The piece-goods trade, in which there is no native competition with the finer classes of goods, has been less affected, but until exchange improves again the foreign trade is bound to languish.

A Backward Province.

An exhibition of provincial exhibits for the World's Fair at San Francisco was held in Foochow during the summer, but the display was not a creditable one for a province of the size and population of Fuhkien, the industrial backwardness of which could hardly have been more clearly demonstrated. The province is still without roads or railways, or any industries other than two wood-sawing mills, for which the use of machinery is essential, and though possessed of considerable mineral resources no attempt is being made to develop them. The poverty of the people is to some extent accountable for this state of things, but the conservatism and lack of enterprise of the native business men is the chief obstacle in the way of progress. The Fuhkienese are also possessed with a somewhat exaggerated idea of the importance of their province and of the temptation it offers for foreign aggression, which they still believe can only be resisted by rejecting all offers of assistance in developing its resources. Until they wake up to the danger of this policy, there is little likelihood of any improvement in the trade of the Foochow Consular district and any consequent expansion in the market it offers for foreign goods. For the benefit of British manufacturers who send motor-car and similar catalogues to the Consulate at Foochow, it may be mentioned that, owing to the total absence of roads referred to above, there can be no wheeled vehicles in use in the district. Transport is by boat wherever rivers, with which Fuhkien is fortunately well supplied, are available, or, where water carriage is impossible, by pack bearer. Animals are hardly used at all, human labour being cheaper.

TREND OF INVENTION IN 1914.*

The subject of locomotion in general maintains its pre-eminence in the field of invention. The flow of applications relating to the many branches of this subject was maintained at about the same rate as in the previous year until the outbreak of war, after which a considerable fall took place.

The great activity noted during the last few years in the motor-vehicle industry appears to have passed its zenith, the number of applications in connection with motor-vehicles and internal-combustion engines, although still great, showing a notable falling-off as compared with the previous year's total. Considerable attention has been given to the cycle type of vehicle, including motor attachments of the "auto-wheel" type to cycles. Tractors for agricultural and military purposes, and signals for indicating to a following vehicle an intention to turn or stop, are also noteworthy features.

The interest in railway signalling has been well maintained, but no marked departures from known types of apparatus are revealed. As a further instance of the interest taken in the safety of railway passengers, a great amount of inventive ingenuity has been applied to the problem of simultaneously locking all the carriage doors of a train from the guard's van.

The outbreak of war naturally provided a stimulus to inventions connected with military and naval subjects, particularly aerial warfare and submarine mining. Bombs and their projection from aircraft have claimed considerable attention from inventors, as also have means for detecting submarines and torpedoes, and for protecting ships therefrom.

Applications for darts, mechanical means for throwing bombs and other projectiles, and body-armour provide an interesting sidelight on the revival of ancient methods of warfare.

Amongst other inventions in connection with military matters may be mentioned bullet-proof shields; periscopes for enabling observations to be made while the observer remains under cover in a trench; sleeping-bags; and combination knives, forks, and spoons.

The issue of Treasury notes of small denomination was the occasion of a considerable number of applications for purses for holding paper currency.

Toys and games, particularly of a warlike nature, are responsible for a large number of applications. Dolls' heads and eyes, previously largely made abroad, and "foot-cycles," now so popular amongst the juvenile section of the community, may also be worthy of mention in this connection.

The disaster to the submarine A 7 directed attention to the problem of locating wrecked submarines, and signalling to and rescuing their occupants.

In the field of aeronautics, in which invention has been very active during the last few years, a marked falling-off is observed.

The interest in visual signal-indicators for mines has been well maintained.

The electrical industry as a whole is very prominent, although few outstanding features call for comment. There has been continued progress

* From the last Report of the Comptroller-General of Patents.

in automatic and semi-automatic telephone systems. Attention has also been given to receiving-arrangements for cable telegraphy, and to ionized-gas relays for use in telephony and wireless receivers.

THE DEVELOPMENT OF THE TEXTILE INDUSTRIES.

Technical Progress.—It is probable that technical progress is more active than could be supposed from the signs upon the surface of affairs. The noticeable dearth of novelties in machinery, processes and goods does not imply that effort and ingenuity have been paralysed. Energies have been diverted, sometimes to the acquisition of forgotten knowledge or to the practice of expedients which are unfamiliar without being new. Most manufacturers have had to make essays in doing without one or another of the things that are ordinarily deemed indispensable, and if the results of these experiments are not showy there is no cause to regard the efforts as wasted. The textile art is essentially one of peace, and war conditions do not help to further it as a whole. One of the broad effects of war has been to promote the production of the plainer classes of goods. For one thing such textiles as are wanted for direct military purposes are distinctly plain; for another the interruptions and uncertainties of war have interfered in every way with the normally lengthy processes of preparing and marketing new goods of a fancy description. As often as possible the old patterns are made to serve again, and all avoidable complexities in any new goods that are introduced are instinctively shunned.

Dyed Goods.—The inadequacy of the dyestuff supply accounts fully for the limitation of fancy effects obtained by the use of colour. Only a select number of colours are available at all, and responsibility for exact matching is altogether disclaimed by the dyers. The difficulty is not with sober blacks, blues and browns, which can be dyed passably well in unlimited quantity, but with the fine, bright and delicate shades wanted to enliven deader colours in the dye-vessel, or for contrast or for bright-hued garments. Very bright, very fast and very level-dyeing colours are scarce, are increasing in scarcity, and are those which dyers in the present most want. Dyers do their best with such materials as they can encompass, but it is scarcely their opinion that all the work they are driven to turn out will yield satisfaction to the ultimate consumer. Some of them live in open expectation of trouble to follow. It does not appear that sellers of goods have made the most of their opportunity to press the sale of fast-dyed cloths. The fact that goods were dyed a year ago instead of a month ago does not mean universally that the colours can be relied on to withstand sunlight and wear, but the presumption is in their favour. It is prudent meanwhile to distrust all bright and delicate shades and to prefer such as were dyed when the choice of materials was abundant.

Conditions in Germany.—The pains taken to conceal the industrial situation in Germany fail at any rate to disguise the fact that the plight of textile operatives in that country is much worse than here. According to information from Geneva, the Concordia Spinning Mills of Bunzlau have their people working for twopence an hour—9·51 marks for 57½ hours. The particulars are taken from tickets which upon the obverse caution the workers to be economical in their use of bread. The internal evidence suggests that the tickets have been issued to women workers. In Saxon Thuringia the weaving manufacturers not long ago conceded war bonuses to their workpeople at the rate of threepence a day to married men and half as much to women and unmarried males. It was provided that in any case married men should not receive more than 22*s.* a week, unmarried men not more than 18*s.*, married women not more than 16*s.*, or unmarried more than 12*s.* Food is reported considerably dearer than in England, and there are several things to show that the German mills are not making anything like the usual six days per week. Some of the finishing works have been employed only two to three days for a considerable while. In Socialist quarters it has been apprehended that 30,000 men in Chemnitz would be thrown out of work by the recent restrictions upon the use of cotton. A safe inference is that there is material want and suffering. More than half the operatives of some mills are with the German army. Approximately half the regular trade of the country has been cut away by the stoppage of exporting, and the prices of materials show the difficulties of importing. Raw cotton in Bremen costs about six times as much as in Liverpool, and in Austria the authorities have lately fixed maximum prices for home-grown wools representing from two to four times the high prices ruling in England. The Austrians, however, have liberty to pay dearer for any imported wool that they can get.

The Labour Supply.—The repair departments of textile mills have been yielding both their men and their machinery for the manufacture of munitions, and the absences are bound to make themselves felt increasingly as small repairs fall due. The cotton-weaving employers in Lancashire, to facilitate recruitment and the making of munitions, have agreed to reinstate all workpeople who may enter the Government service. A similar understanding may be expected in other important cases. A certain number of textile mills were until a fairly recent date employed mainly or fully upon direct or indirect Government work, and while such was the case it was realised by all that their men could not be spared for the ranks. Now that there is a lull in official contract work some of those people have become presumably eligible. However, it is to be believed that large contracts

will come again, and in these circumstances an employer feels an intelligible reluctance to part with his staff. The difficulty is one that should give way to organisation, and the data elicited by the National Register are likely to secure full attention to it. The worst fears of the unreasonableness of officials have not been realised as yet, and in proceeding by conferences, in which employers, employed, and the officials participate, there is every promise of a mutual understanding.

The Bishop Blaize.—There are "Bishop Blaize" inns in two or three of the towns in which woolcombing is at present done. A century ago Bishop Blaize processions formed a regular feature of the wool-combers' year, and the effigies of the Bishop upon tokens and handbills show him as patron saint of the combing trade. It does not appear, however, that he, like the father of Columbus and some other distinguished persons, worked at the craft. The combers have not even a monopoly of his patronage, for at various times and places he has been the saint also of weavers, builders and masons, the patron equally of swine and the great protector against wild animals and throat complaints. His association with combing arose out of the probably erroneous supposition that he was done to death with woolcombs instead of with the *ungulae* or hooks forming the common instrument of torture in Roman times. The probabilities have been examined in a notably able paper given to the Society of Antiquaries by Mr. H. Ling Roth, and now republished in Bankfield Museum Notes (Halifax: King, 2*s.* 8*d.*). The author's conclusion is that Blaize and woolcombing became associated first between the tenth and twelfth centuries. About the end of the eighteenth century Blaize was in the zenith of his fame among the craft in England. The cruel impoverishment of combers at the time of the advent of machinery might account for the disappearance of the rites of celebration; but if little honour is paid nowadays to the martyr he yet remains the traditional saint of the trade. Custom seems to appoint February 3rd as the date of commemoration.

Cotton as Contraband.—Members of the cotton trade are not nearly so enthusiastic as some others in urging the inclusion of raw cotton in the British list of contraband. The closer one is drawn to the trade, the more one recognises complexities not clearly apparent from a distance. There are no two opinions about the necessity for withholding cotton from the enemy. The belief is widely held that to declare cotton contraband would not make its supply to the enemy more difficult than at present, and would intensify the dissatisfaction of neutral nations whose goodwill is of some moment. The delicate points in the present situation are appreciated as keenly by cotton traders as by anybody; and, perhaps rather more than most people, they realise their responsibilities towards the future. It is important to remember that cotton can in no case be raised in this country, and that there may be future wars, fought in different conditions, when a precedent set now for the sake of a doubtful advantage might be used to the grave detriment of a large part of the industrial population. The considerations are weighty enough to deter spinners from joining uncritically in a popular cry raised—as they believe—by persons of less responsibility and understanding than themselves. There are no discoverable objections against making cotton contraband providing that the step is taken after the fullest consideration.

British Wool.—The idea that the war has still a long course to run is emboldening buyers of the British wool clip to pay higher prices than the market immediately warrants. The advance upon last year's prices is about 50 per cent., at which it is possible that some varieties represent a better speculation than others. There seems to be more prospect of large new contracts for hosiery than for army cloth, so that the Downs or shorter wools are favourites. Last autumn quantities of long British wool were used in the absence of a sufficiency of New Zealand crossbred, of which the supply this year is more abundant. There is no invariable rule to that effect, but Nature is often merciful in years of high prices, and wool merchants are free to admit that this year the fleeces are uncommonly thrifty. The unwashed wools from some districts are computed to yield fully 5 per cent. better than the average. The comparative absence of grease and moisture is much more than offset by the enhanced price, but the small advantage is gratefully received by the buyers. The height of prices and the restriction of bank credits limit the ability to buy speculatively, and financial influences are perhaps destined to become still more effective in curtailing the advance of quotations.

CORRESPONDENCE.

MUNITION METALS.

I have noted the summary (contained in the *Journal* of July 23rd) of Professor H. C. H. Carpenter's contribution on the above subject to *Nature*. With reference to zinc and antimony, the latter having reference to China, I wish to say that if zinc can be handled in furnaces here at home it can be bought in very large quantities in Bolivia and shipped from the mine and landed in England within twenty-four days. Antimony can be bought at Uyuni, Bolivia, for £4 per ton of high-grade ore. The British Vice-Consul at Uyuni is in an excellent position to advise on output, prices, etc., of these and other munition metals.

The writer has just returned from Bolivia, and is desirous to have British manufacturers know where munition metals, such as copper, lead, zinc, antimony, etc., can be obtained quickly. Regular steamship service is maintained to and from the west coast (South American) ports.

Burnley, Lancashire, July 24th, 1915. WILLIAM T. TAYLOR.

GENERAL NOTES.

THE GERMAN AMBER INDUSTRY.—The harvest of amber on the German shore of the Baltic Sea was very satisfactory in 1914. According to reports of the Prussian Government, which holds the monopoly of the entire German amber production, the output last year reached 800,000 carloads of 1,100 lb. each of alluvial wash containing amber, each carload netting 1·2 lb. of raw amber. The output of the works amounted to 478 metric tons (of 2,204·6 lb.) of raw amber, 28 metric tons of pressed amber, 236 metric tons of molten amber, 4 metric tons of succinic acid ($C_4H_6O_4$), and 55 metric tons of amber oil, the aggregate value being £250,000. The net earnings of the works, which employ about 1,500 men, amounted to £35,000. In view of the increased demand for amber, the output does not keep up with the demand, although the works are running full time.

ORIGIN OF PETROLEUM. — The long-debated question as to the origin of deposits of petroleum, is dealt with by the investigations of M. Jean Chautard, the result of which was recently presented to the French Academy of Science. According to this gentleman's researches in different parts of the globe, the petroleum-bearing rocks never present characteristics denoting an igneous origin. They are invariably sedimentary rocks, and, moreover, they all contain deposits which indicate alternations of marine and lagunary conditions. Such alternations are, of course, the sign of intermittent regressions of the waters covering them. "This fact," according to the *Bibliothèque Universelle* of Lausanne, "enables us to form an idea of the conditions favouring the formation of petroleum. During the lagunary periods there was an accumulation of organic *débris*, the remains of animals and vegetables which had either lived or died there. The marine recurrences brought impermeable sediments which covered the *débris* and protected them from the oxidizing action of the air, thus permitting them to become bituminous. Hence petroleum would appear to be of organic origin and not mineral.

FOREIGN TRADE OF JAPAN.—The latest statistics of the foreign trade of Japan, covering May and the five months to the end of that month, reveal a fairly substantial decline as compared with the corresponding periods last year. The total value of exports during the month amounted to £5,114,100, against £5,391,700, while imports amounted to £5,741,900, against £6,156,500. The aggregate value of the month's trade was, therefore, £10,856,000, in comparison with £11,548,200 in May, 1914, and showing an excess of imports of £627,800, against £764,800. Exports for the five months reached a value of £24,545,700, showing a decrease of £1,849,900 when compared with the first five months of 1914. Imports at £24,459,200 exhibit a much greater drop of £7,322,000, so that the total trade for that period was some £9,171,800 down at £49,050,000. There was an excess of exports over the five months of £86,500.

ELECTRIC MACHINERY IN CHINA.—H.M. Consul-General at Shanghai reports that the importation of machinery and the installation of electric-lighting apparatus in China is worthy of the closest study by British firms who are interested in the machinery market. China shows a vigorous and increasing demand for electricity in all its branches. The Shanghai Municipal Electricity Works supplied over 40,000,000 units during 1914, as compared with 21,000,000 units in the previous year; 1,500 radiators have been installed in Chinese houses, and small motors are very popular. The installation of plant in the interior requires special measures, and cannot be attempted without efficient local representation. The business was largely in the hands of German firms, mainly because they were willing to undertake entire contracts and to finance them. British firms, however, have realised the possibilities of the market, and those who have been sufficiently enterprising to meet the local conditions are being amply repaid for their trouble, whilst their work has given the greatest possible satisfaction to the Chinese companies on whose behalf contracts have been undertaken. British installations have recently been completed for the great cities of Soochow, Changchow, and Yangchow, in the Province of Kiangsu, and for Ningpo, in the Province of Chehkiang, whilst a very large number of smaller plants and dynamos have been supplied for lighting small towns, missions, and factories.

SWISS POSTAL STATISTICS IN WAR TIME.—The following statistics, issued by the Federal post office in Switzerland, give some idea of the magnitude of the work imposed upon that department by the existing war conditions. During the month of May no fewer than 2,084,175 letters or post-cards, 215,530 small packets, and 976,649 packages by parcels post, addressed to French prisoners in Germany, passed through the Swiss post office, whilst the mail forwarded to the German prisoners in France comprised 2,944,775 letters or post-cards, 55,255 packets by letter, and 77,083 by parcels post. In addition, 52,772 post-office orders, representing a value of 1,748,535 francs (£69,742), were issued for French prisoners in Germany, and 24,917 orders, to the value of 415,441 francs (£16,617), were issued for German prisoners in France. During the same month, the amount of mail handled daily by the Swiss post office for the benefit of the prisoners of war averaged 162,224 letters and post-cards, 8,735 small packets, and 33,991 packages by parcels post. An average of 6,656 post-office orders, to the value of 92,424 francs (£3,697), were issued daily. The total number of parcels sent by post since September, 1914, to end of May, 1915, was 2,625,179 to French prisoners in Germany, and 565,097 to German prisoners in France.

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All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

PETER LE NEVE FOSTER PRIZE.

Mr. Reginald Le Neve Foster has presented the Society with a donation of £140 for the purpose of founding a prize in commemoration of his father, Mr. Peter Le Neve Foster, who was Secretary of the Society from 1853 to 1879.

The Council have determined to offer the prize for a paper on "Zinc, its Production and Industrial Applications."

The prize will consist of a sum of £10 and the Society's Silver Medal.

The paper for which the prize is awarded will be read at one of the Ordinary Meetings of the Society.

It is expected that some account will be given of the history of the metal, the sources of its supply, its metallurgy, and the various uses to which it has been, or may be, applied.

Intending competitors should send in their papers not later than December 31st, 1915, to the Secretary of the Royal Society of Arts, Adelphi, London, W.C.

The paper must be type-written. It may be sent in under the author's name, or under a motto, accompanied by a sealed envelope enclosing the name, as preferred.

The judges will be appointed by the Council.

The Council reserve the right of withholding the prize or of awarding a smaller prize or smaller prizes, if in the opinion of the judges nothing deserving the full award is sent in.

FOTHERGILL LECTURES ON "MOTOR FUELS."

The Fothergill Lectures on "Motor Fuels," by Professor Vivian B. Lewes, F.I.C., F.C.S., have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Royal Society of Arts, John Street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

OILS, THEIR PRODUCTION AND MANUFACTURE.

By F. Mollwo Perkin, Ph.D., F.I.C., F.C.S., M.Inst.P.T.

Lecture II.—Delivered January 25th, 1915.

The shale-oil industry is one of great importance to Scotland, and in these days of depreciating British method and British enterprise may be pointed to as a triumph of engineering and chemical skill over very great difficulties. That an industry dependent upon the distillation of shale, from which, on the average, only 23 gallons of crude oil per ton are obtained, has been able to hold its position against the enormous competition of oil obtained from the oil-fields is, indeed, something to be proud of, and it has only been done by strictest attention to detail and continual improvement in method.

The shale-oil industry in this country was founded by Dr. James Young, who was manager of a chemical works in Liverpool. In 1847 Dr. Lyon Playfair—who afterwards became Lord Playfair—drew Dr. Young's attention to a small stream of oil which flowed from some coal workings at Alfreton in Derbyshire. From this oil Young succeeded in abstracting, on a commercial scale, wax and burning oil and a heavy lubricating oil. As, however, the supply of raw oil soon became exhausted, Dr. Young, believing the oil to have been produced by low temperature distillation of coal by terrestrial heat, endeavoured to obtain oil by slow distillation of coal in retorts. He experimented with a large number of English and Scottish coals, and finally found that the Torbanehill or Boghead coal in West Lothian yielded from 120 to 130 gallons of oil per ton of coal distilled. In 1850 Young took out a patent for "obtaining paraffin oil, or an oil containing paraffin, from bituminous

coal." By the end of the same year the Bathgate Oil Works were started under the name of Young, Meldrum and Binny. The Torbanehill deposits were worked for about twelve years, when they became exhausted, and since that time the Scottish shales of Linlithgow and Midlothian have been the principal source of supply.

It is interesting to note that Young's process was largely worked in America until the advent of natural oil in 1859 and the accompanying oil fever. Oil shale is dark grey or black in colour, and usually has a laminated or horny fracture. Shales do not coke when heated, and, as the mineral content is very high—generally over 70 per cent.—the spent shale is practically of no use, as is evidenced by the huge dump heaps which are to be seen at the shale-oil works, and are by no means beautifying to the landscape.

The quantity of oil and of sulphate of ammonia yielded by shales varies considerably. It may be as high as 30 to 40 gallons per ton of shale, but is sometimes as low as 17 to 18 gallons. The original shales worked by Young yielded from 40 to 45 gallons per ton, and with present-day methods of retorting would undoubtedly have yielded more. The average yield in Scotland to-day is, however, only 23 gallons per ton. The amount of sulphate of ammonia yielded depends largely upon the percentage of nitrogen in the original shale.

Young's patent expired in 1864, and this led to a great expansion in the Scottish oil industry; but shortly afterwards, owing to the output of natural oil and the American competition, it experienced a severe check. The discovery in 1859 by E. L. Drake of oil wells in Pennsylvania was followed by the importation into England of lamp oils. In the early days of the shale-oil industry lamp oil was the principal product, and during the run of Young's patent fetched about 2*s.* 6*d.* per gallon. After the expiry of the patent it fell owing to competition to 1*s.* 6*d.*, and when the American oil came on to the market the price dropped much lower, until to-day illuminating oil can be obtained for about 5*d.* per gallon, and the price has even been lower.*

At first the Americans exported chiefly illuminating oils, but after a time they supplied lubricating oils and solid paraffin. In 1871 there were fifty-one oil works in Scotland, which produced about 25,000,000 gallons of crude oil. As the American competition increased, the smaller works gradually fell out and the larger works increased in size. Mechanical and labour-saving arrangements were devised, the retorts were improved, purer oil was produced, and the chemicals used in refining were as far as possible recovered. About this time the supply of Peruvian guano began to fail, and, as a consequence, the price of sulphate of ammonia began to increase. In 1880 the price of sulphate of ammonia was £22 to £24 per ton. In 1890 it had dropped to less than £8 per ton, and illuminating oil did not fetch more than 6*d.* per gallon. Further concentration of the works took place. The retorts were specially constructed to give the maximum yield of sulphate of ammonia, and improvements were introduced to produce greater economy throughout the works. With the older retorts not more than 16 lb. of sulphate of ammonia was produced per ton of shale. With the new retorts 35 lb., and even 75 lb., of sulphate of ammonia is obtained per ton, depending, of course, upon the quality of the shale. With the older type of retort it was necessary to produce 30 gallons of oil per ton for the working to be profitable; with the new retorts 20 gallons is profitable. Since 1873 the Russian petroleum industry has developed, and the competition from this source has of recent years been very severe. As, however, paraffin wax is not produced from Russian crude oil they could not compete in this direction, and the manufacture of paraffin wax has always been a profitable undertaking.

One of the chief reasons why the Scottish oil companies have been able to hold their own is healthy rivalry and mutual helpfulness. This has resulted in concentration, and now there are only seven companies, three of which produce only crude oil. Although there are fewer companies (in 1894 there were thirteen), the output of oil and of sulphate of ammonia has increased instead of, as might have been supposed, decreased.

The amount of shale treated in the retorts is over 3,000,000 tons per annum, which produces about 275,000 tons of crude oil, or over 70,000,000 gallons. The marketable products produced by the distillation and refining of the crude oil and their approximate yields are:—

Motor spirit	600,000 gallons.
Naphtha	4,400,000 „
Burning oil	20,000,000 „
Gas or fuel oils . . .	12,000,000 „
Lubricating oils . . .	10,000,000 „
Paraffin wax	25,000 tons.
Sulphate of ammonia .	55,000 „

The total value of the products exceeds £2,000,000 per annum.

* Owing to the war, prices are at present much higher.

METHOD OF MANUFACTURE.

The shale is mined and brought to the surface in hutches. Where necessary it is blasted down by gunpowder. Fig. 3 shows an electric drill which is used to bore the blast-holes. Before being brought to the surface the shale is passed over a 1-in. riddle, all the smalls being left behind in the mine. After being brought to the surface the shale is passed through a breaker, where it is broken into pieces about 6 in. square. It is then discharged into iron tubs, which are run along rails and discharged into the retorts. Fig. 4 illustrates the Bryson retort used at the Pumpherston Oil Companies works. It is long and narrow. There is an iron table below for supporting the shale, and a revolving arm to cause the shale to move downwards.

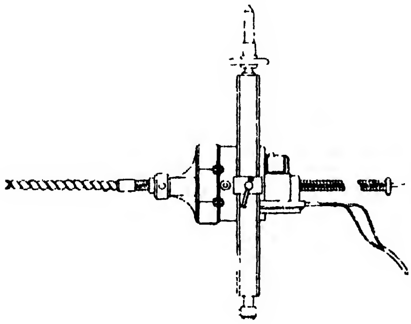


FIG. 3.

Through the centre of the table a steel spindle or shaft projects, on the upper end of which is a curved arm, and this, when rotated, pushes some of the shale off, causing it to fall over the edge of the table into the hopper below. The shaft carrying the curved arm passes through a stuffing-box on the hopper, and has a ratchet and lever fitted to the lower end actuated by a bar or rod of T-iron, which is made to travel horizontally and is driven by gearing from a small electric motor. The motion is comparatively slow, the arm making only one revolution in twenty minutes, and the action is most satisfactory, the throughput of shale being regulated at will. The upper portion of the retort is of cast-iron, 11 ft. long by 2 ft. in diameter at the top, enlarged to 2 ft. 4 in. at the bottom. The lower part is built of firebrick and is about 20 ft. long enlarged to 3 ft. at the bottom. Heat is applied externally from uncondensable gases obtained from the distillation of the shale (assisted, in the case of the poorer qualities of shale, by producer gas), and is made to circulate round the retort by chequers. The heating gas enters near the bottom of the brick portion of the retort, along with a certain quantity of air, and a high temperature (650° C. to 900° C.) is maintained in this portion, where the nitrogen of the shale is converted into ammonia, which is aided by a continuous supply of steam delivered at a slight pressure into the bottom of the hopper. The oil vapours and gases are distilled from the shale in the cast-iron portion at a temperature of about 500° C., and, along with the ammonia gas, are drawn off by the exhausters, at a branch pipe at the top of the cast-iron retort, through the atmospheric condensers. The condensed liquid oil and water containing ammonia flows into a small separating tank. The gases then pass through ammonia scrubbers in which they are "washed" for ammonia, then through the naphtha scrubbers, where the lighter gases, which could not be caught in the atmospheric condensers, are scrubbed with oil, and a good quality of light oil or naphtha is recovered. The uncondensable portion passing from these scrubbers is burned under the retorts. Shales of average quality yield sufficient gas, not only to heat the retort, but also to burn under the steam boilers.

The ammonia water got from the atmospheric condensers is pumped through a heater, in which

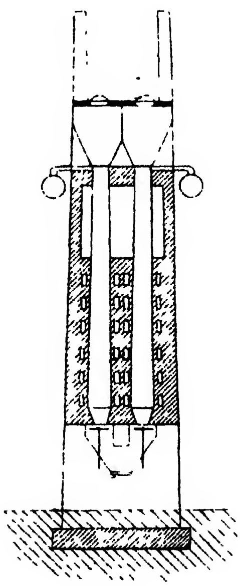


FIG. 4.

it is raised in temperature by the spent or waste water flowing from the still, and passes into the top of the still, which is circular in shape, about

30 ft. high, and has a series of cast-iron shelves fixed horizontally every 2 ft. or thereby from the top to near the bottom. Steam is injected into the bottom of the still, and passes to the top carrying with it the volatile ammonia, while the water, after traversing the whole area of each tray, passes down by a seal-pipe from one to the other, and flows out at the bottom as spent water into a concrete tank containing a cast-iron worm, which acts as a preheater for the ammonia water on its way to the still. During its progress from the top to the bottom of the still, the water is diverted into a chamber containing milk-of-lime, which sets free the fixed ammonia.

The ammonia as it is liberated from the still is passed into a lead-lined saturator containing sulphuric acid, where it is converted into sulphate of ammonia. As showing the care which is exercised to prevent waste, the exhaust steam and waste gases from the saturator are passed into the retorts and utilised to aid in the formation of ammonia from the shale.

Refining the Oils.

The oil as condensed in the coolers is a black, semi-solid liquid. It is pumped into overhead tanks, which are so arranged that the stills can be fed by gravitation. Before being run into the still, the oil is allowed to settle from twelve to eighteen hours, being kept sufficiently warm for it to remain quite fluid, so that the water may the more readily settle. The oil is then fed into the centre still of a battery of oil boilers (Fig. 5). The lightest fraction of oil which consists after purification of naphtha and illuminating oil is distilled off in the first boiler. The stills on each side of the feed-vessels are fed with oil by means of a pipe passing to the bottom of the first still, the heavier oil passing in a similar manner to

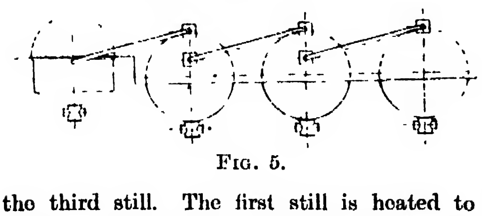


Fig. 5.

the third still. The first still is heated to a temperature sufficient to distil off the light oil, the second to a higher temperature to distil off the fuel oil, and the third to take off the lubricating oil. Thus, fractions of different specific gravity are collected. After the third fraction has been taken off, the heavy oil is delivered into a cast-iron pot-still, where it is distilled to dryness, and a residue of oil coke is left behind. This oil coke is valuable for making electrodes, as it is a fine form of carbon and contains very little ash. At all stages of distillation steam is let into the retorts to aid the distillation and to prevent decomposition.

Condensers.

The various fractions of oil are treated separately with sulphuric acid and soda, and

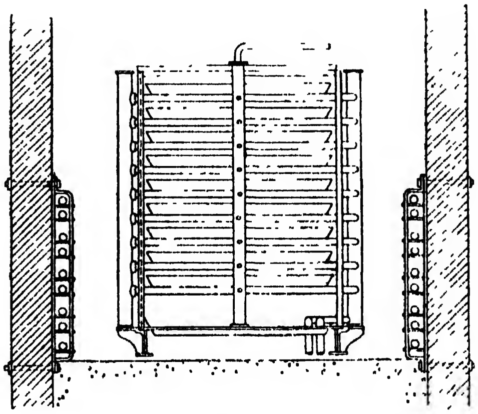


Fig. 6.

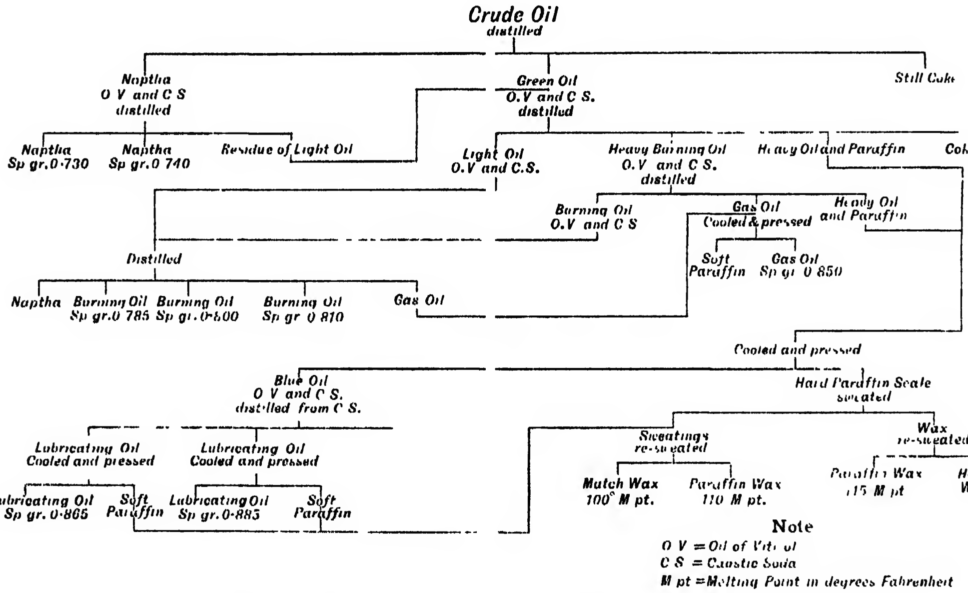
then refractionated to produce the different oils required. On treatment with sulphuric acid a tarry product is produced which is removed from the oil. This tar is then treated with water, when the tar and acid separate. The acid is used for making sulphate of ammonia, and the tar is burnt under the stills. Consequently, the distillation is carried out without cost for fuel, except what may be necessary for steam-raising.

After purification of the oil it is, as already mentioned, redistilled, and at one stage a heavy or "green oil," as it is called, is obtained. This is semi-solid and is placed in the paraffin sheds to be cooled. It is then filter-pressed, when the paraffin scale is obtained. The cakes are transferred from the filter press to hydraulic presses, where the remainder of the oil is squeezed out. The paraffin still contains small quantities of oil, which give it a yellow colour and lower its melting-point. To rid it of the last traces of oil it is sweated—that is, placed on large iron trays having false bottoms of iron lattice-work, water being pumped in to cover the lattice-work. Fig. 6 illustrates the Henderson sweating trays. The "scale" is melted and pumped into each tray to a depth of about 2 in. It is then allowed to cool and solidify. The water is run off, and the temperature of the chambers in which the trays are placed is gradually raised

by steam-heating. The scale on heating expands and becomes porous, and the oil in it slowly drains out. The sweating is continued until the desired melting-point is obtained. The paraffin so obtained is finally melted, mixed with powdered charcoal to decolourise it completely, passed through filter paper and then into moulding trays.

Shale oil is mainly a mixture of the paraffin and olefine series of hydrocarbons, but contains a small admixture of hydrocarbons of the naphthene and benzene series. The paraffins and olefines occur in the motor spirit and in the burning oils. In the heavier products, such as solid paraffin wax, the paraffin series alone is present. On the other hand, the lubricating oil is a mixture of olefines and paraffins. The crude oil also contains phenolic and nitrogen compounds, both of which are removed by the acid and alkali treatments. Unsaturated sulphur compounds which are present in the crude oil give it a very unpleasant smell, and the object of the refiner is to remove these, but not to remove the olefines. The olefines, as has already been mentioned, dissolve in strong sulphuric acid; therefore, if large quantities of acid were used in the refining process, the yield of oil would be reduced and the cost of refining increased. Only sufficient acid for purification purposes may, therefore, be added.

A general scheme showing the products obtained from oil shale is shown above. Shale does not itself contain oil. It is only produced by the destructive distillation of the organic matter contained in it. The oil-producing material in shale is called kerogen, and this, when subjected to low-temperature distillation, splits up into gases and the products we have been examining. The upper part of the retort, it will be remembered, is heated to a temperature of about 500° C., and it is here that the oil is produced and distilled off. As the shale drops down into the lower parts of the retort, it becomes more strongly heated to 700° or 800° C., and steam is passed in: here ammonia is produced. If the fresh shale were heated at the commencement to 700° or 800° C., a different class of oil would be produced and much larger quantities of gas. We should obtain more hydrocarbons of the aromatic series, and less lubricating oils and paraffin wax. In the shale-oil works the problem is to obtain as much oil and wax as possible, also sulphate of ammonia. It is, therefore, necessary to employ a low temperature at the commencement to obtain the oil, and a higher one at the end to get the greatest yield of ammonia. In gasworks' practice the opposite is the case. Gas is the main product. Consequently, the coal is heated to a high temperature, and large volumes of gas are obtained, together with hydrocarbons of the aromatic series. Owing to the large demand for oils, low-temperature processes of carbonisation have recently come very much to the front again. It is found that coals, when distilled at low temperature, yield paraffin and olefiant hydrocarbons, and only small quantities of oils of the aromatic series.



Low Temperature Carbonisation.

Recently a great deal of experimental work has been carried out in connection with the distillation of coal, lignite, shale and peat, and if the rather extravagant hopes of those who designed the various retorts have not matured, it has at any rate been proved that large yields of valuable oils can be obtained at a comparatively low cost for fuel and labour. There has been far too much loose talk about extraordinary yields of motor spirit, and those interested have endeavoured to squeeze out every drop of so-called spirit and have greatly exaggerated the actual yield of this very saleable article. Sufficient attention has not been directed to the important fuel oil which is obtained in much greater abundance. There are also large quantities of intermediate oils and considerable quantities of paraffin wax. The methods of distillation have not been sufficiently studied, and crude products have been classified as if they had been refined. Owing to the exaggerated claims of inventors, much disappointment has been met with by coal-owners and others who have subjected their minerals to distillation on the various retorts. Personally, I believe that there is a very great future in front of distillation at low temperatures, but we must get away from wild-cat schemes and exaggeration. One of the chief points to consider is: What does the market require? Is it a smokeless fuel, with good oil and a minimum quantity of sulphate of ammonia, or a very poor oil with a maximum yield of sulphate of ammonia and large quantities of gas? or, thirdly, a good yield of good oil, large quantities of gas and of sulphate of ammonia?

1. The first is a low-temperature carbonisation process.
2. The second is a producer-gas problem.
3. The third is a combination of low temperature carbonisation and afterwards producer gas.

In the original coalite process the first-mentioned was aimed at—that is to say, to produce a good smokeless fuel and ammonia, oil and gas being by-products. The same remark applies to the Del Monthe and the Tarless Fuel Syndicate processes. In other cases, particularly in dealing with peat and with coal residues, the second process was the one most favoured, for example, by the Power Gas Corporation, Ltd. In this process the material dealt with is burnt in a mixture of air and steam, the carbon is completely burnt, most of the nitrogen present in the original material is converted into ammonia, and a large volume of producer gas is obtained. The tar, however, which is also formed, yields a very poor oil. In industrial centres, where large quantities of cheap gas are valuable for motive purposes or for heating furnaces, the second will be by many considered the best business proportion. I am not certain, however, that a combined process will not in the long run be the most economical. There is not always a good market for smokeless fuel; for oils the market is always on the increase, and sulphate of ammonia is always, and will be always, a valuable fertiliser. If at the same time producer gas can be produced at a very low cost, another source of profit is present.

When coal or lignite is distilled at low temperature, oil is obtained together with gas and ammonia. The amount of oil produced depends mainly, but not entirely, on the amount of volatile matter present. Generally speaking, for each per cent. of volatile matter present one gallon of crude oil may be expected. This, however, is not reliable, because with some coals less than one gallon per cent. is obtained, and with other coals considerably more. The subject is one of great interest and would well repay further research—not on a laboratory scale, however. It is necessary to do it on a fairly large plant.

The first process may be carried out by itself or as a prelude to the third—that is to say, the coal, lignite, shale or peat is first distilled at a low temperature, which produces the oil and a certain quantity of ammonia and gas. The product remaining, which carries most of the fixed carbon and a certain proportion of volatile matter, is then treated in a producer, when the rest of the ammonia is obtained, together with a large amount of gas and a small quantity of tar. It is very doubtful whether such a process would be satisfactory in dealing with shales, which always have a large percentage of mineral matter. Shales certainly must be distilled at a low temperature, but should then be acted upon by steam at a higher temperature to obtain the maximum yield of ammonia. This need not necessarily be done with the vertical retorts used in Scotland, but could be carried out by modifying other forms of retort. Very good yields of oil have, for example, been obtained on retorts working on the Del Monthe and the Tarless Fuel Syndicate principles.

The Del Monthe is a continuous working retort which has an endless screw in the centre. The screw carries the coal or shale forward

through a cool and then a hotter zone until it is dropped into the hopper. The retort is of the horizontal type and is built at an angle of about 30°, the higher end being the hotter. The material is fed into the lower end and continuously discharged at the upper end. The gases and oil vapour produced by the carbonisation are caused to pass back through the cold material. This has a twofold effect. The gases and oil vapour are partially cooled, and thus decomposition is prevented, and as the gas parts with its heat the material fed in becomes heated. The actual form of the retort is a long iron tube which is heated externally. The endless screw is cast upon a tube, which is heated internally by a form of Bunsen burner, so that the material is heated both from the outside and inside. Small quantities of steam are allowed to pass in at the hotter end of the retort, or water is allowed to drop in, which answers the same purpose. If the material being dealt with contains large quantities of moisture, such, for example, as peat, then the admission of steam or water is unnecessary. The oil and gases as they leave the cooler end of the retort are passed through condensers and scrubbers, where the oil is collected in fractions and the ammonia washed out of the gas. The uncondensable gas is collected in a gasometer, and is employed for heating the retort. As a rule, more gas is obtained than is necessary to carbonise the product under treatment. The residual gas can be employed for raising steam for power purposes. About 5,000 cubic feet of gas is obtained per ton which differs from ordinary coal gas, as it is relatively poor in hydrogen, but rich in carbon monoxide and saturated hydrocarbons. When a non-coking coal is carbonised in this retort a useful smokeless fuel is obtained which contains from 8 per cent. to 11 per cent. of volatile matter. Most of the nitrogen remains in the fuel, and the question which arises is whether the product shall be sold as a smokeless fuel or shall be burnt in a producer to obtain ammonia and gas. There should be no difficulty in discharging the hot material directly into a producer, and thus economising heat. In dealing with shales, it would probably be better to lengthen the retort and to increase the heat at the far end, and at the same time to pass in superheated steam. Partially carbonised shale is useless as a smokeless fuel, owing to the large amount of mineral matter present, and would not, therefore, burn satisfactorily in a producer.

Bituminous and coking coals cannot be satisfactorily carbonised in the Del Monthe retort as at present constructed. They swell up, and in a short time absolutely block the working of the archimedean screw. By increasing the distance between the screw and the sides of the retort and altering the pitch of the screw this may to a certain extent be overcome; but it is doubtful whether a mechanical arrangement which depends upon the forward carry of a screw will ever be satisfactory with a coking coal. With lignite, shale, peat and wood the method works exceedingly well.

Appended are the results obtained from the carbonisation of a shale and coal on this retort:—

SCOTTISH CANNEL COAL.

Moisture	7·30 per cent.
Volatile matter	31·47 ,,
Fixed carbon	36·93 ,,
Ash	24·30 ,,

Yield of oil, 37 gallons per ton.

Approximate Yield of Oil after Fractionation.

Motor spirit	1·0 gall. per ton.
Fuel oil	6·3 ,, ,,
Heavy oil	16·9 ,, ,,
Wax	3·0 lb. ,,
Pitch	124 0 ,, ,,

NEWFOUNDLAND SHALE.

Moisture	1·54 per cent.
Volatile matter	22·35 ,,
Fixed carbon	2·92 ,,
Mineral matter	70·65 ,,
Nitrogen	0·24 ,,
Sulphur	2·30 ,,

On distillation 26 gallons of crude oil was obtained per ton of shale, the specific gravity of the oil being 0·920. On fractionation the following fractions were obtained:—

Water	0·05 per cent.		
Oil to 150° C.	1·20	,,	Sp. gr. 0·796
,, 250° C.	16·50	,,	,, 0·840
,, 360° C.	62·20	,,	,, 0·902
Residue	13·00	,,	
Loss	7·05	,,	

The process developed by the Tarless Fuel Syndicate works on quite different lines. The retort is vertical, and consists of two concentric cylinders between which the material to be carbonised is charged in. The heat is obtained in the first place by a producer, and afterwards by burning the gases obtained by the carbonisation. The flame passes round the retorts and up through the central cylinder, which is fixed to

the sides of the outer tube by radial flanges which serve to distribute the heat. The retort is charged with the material to be carbonised, which is first passed through a crusher to break it into pieces about 2 in. square. The retort is then closed, and a vacuum of about 27 in. put on to it. The gases as they are produced are thus drawn off through the condenser system, and the carbonisation takes place at a lower temperature than it would do under atmospheric pressure. Furthermore, another advantage of the vacuum is that the gases are immediately led away from the hot retorts, and thus decomposition is prevented. Every three or four hours the material is discharged by opening the tops and bottoms of the retorts and pushing down the charge by means of iron rods.

These retorts will deal with both non-caking and with caking coals, and a most excellent smokeless fuel is produced. Indeed, with coals which would ordinarily be considered non-caking a very good caked material is obtained. Gradual heating of the coal causes greater swelling, and this is increased by the vacuum, which abstracts the gases as they are produced from the more or less pasty material. The caking of the coal does not cause it to adhere to the sides of the retort, and there is no difficulty in pushing it down when the bottom is opened. The yield of oil is very similar to that obtained on the Del Monthe retort. The amounts of ammonia and gas produced are also very similar. Instead of producing a smokeless fuel the product can be burnt in a producer, and excellent results have been obtained in this way. Appended are the results of a coal and a shale which were treated on these retorts:—

YORKSHIRE COAL.

Analysis.

Water . . .	4·95 per cent.
Mineral matter	5·13 ,,
Volatile matter	29·49 ,,
Free carbon .	60·43 ,,
Nitrogen . .	1·40 ,,
Sulphur . .	3·22 ,,

On carbonisation, 18·0 gallons of water-free oil were obtained per ton of coal, which yielded:—

Motor spirit	3·00 gall. per ton.
Intermediate oil . . .	2·51 ,, ,,
Fuel oil	8·50 ,, ,,
Paraffin wax	8·00 lb. ,,
Pitch	50·00 ,, ,,

The yield of sulphate of ammonia was 22 lb. per ton.

SHALE FROM BULGARIA.

Analysis.

Moisture	0·46 per cent.
Mineral matter . . .	65·31 ,,
Volatile matter . . .	34·14 ,,
Fixed carbon	0·09 ,,
Nitrogen	0·17 ,,
Yield of crude oil . . .	27 gall. per ton.

On fractionation:—

Distilled below 160° C. .	2·20 gall. per ton.
,, ,, 270° C. .	8·75 ,, ,,
,, above 270° C. .	11·93 ,, ,,
Residue	27·66 lb.

The coalite retorts are long cylindrical iron tubes which have a slight taper from the top to the bottom. The products of distillation are led off at the top, and the gases are scrubbed and worked in the usual manner. The oils produced are similar to those just described—that is, they contain mainly paraffin and olefine hydrocarbons and very little benzene and aromatic hydrocarbons. The following is an analysis of coalite tar made by Mr. A. R. Warnes:—

Distilled to 170° . . .	10·8 per cent.
,, 170°–270° .	20·0 ,,
,, 270°–350°	30·0 ,,
Pitch	39·2 ,,

There are enormous beds of poor qualities of coal which can be readily distilled on a low-temperature plant, and will yield valuable fuel oils and sulphate of ammonia. Some of the higher fractions, after the removal of the paraffin wax, can be used as lubricating oils. There are also great peat bogs which at present are of practically no use. Peat, when partially dried and distilled at low temperatures, yields large quantities of oils which are rich in hydrocarbons of the paraffin series. The lower fractions can be used as motor spirit, the higher as a fuel oil. A peat-fuel oil which I have analysed, and which still contains the phenolic bodies which lower the calorific value, has a calorific value of 16,500 B.Th.U. The yield of oil from the particular peat from which this fuel oil was obtained was about 30 gallons per ton of peat carbonised.

Another source from which considerable quantities of oil is obtained is from the blast-furnace recovery plant. In Scotland, and in some part of the north of England, splint coal is employed in the blast furnaces in place of coke. Bearing in mind that blast furnaces are employed for smelting iron, anyone who has seen the white-hot liquid metal streaming out

of the tap-hole would hardly be inclined to consider that the distillation of coal in the furnace was a low-temperature one, and yet it is. The coal is fed in at the top of the furnace, which is the coldest zone, being mainly heated by the hot gases which pass up. The volatile matter is driven off as the coal and iron ore gradually pass down the furnace, and the actual reduction of the ore is produced by the coke formed as the volatile matter is driven off from the coal. The top of the furnace is, of course, closed in, and the gases, together with volatile matter, are immediately drawn off and passed through dust arrestors, and then through a complicated cooling and scrubbing system. Sulphate of ammonia is produced from the condensed and scrubbing water, and the heavy tar, having a specific gravity of 0·950 to 0·960, is distilled, giving a light and heavy oil. These oils contain about 20 per cent. to 25 per cent. of phenolic bodies, which make very good disinfectants. The pitch left after distillation, although not quite so good as that produced from the gasworks, obtains a ready sale. The oils make very good fuel oils, although at one time there was a difficulty in disposing of them. Enormous quantities of gas are obtained and used as motive power for gas-engines and for burning under boilers. The large residue is employed as a fuel for steel furnaces. The oils obtained consist largely of hydrocarbons of the olefiant series and of methylated aromatic hydrocarbons. There is very little paraffin wax present. The yield of tar oils from the blast furnaces in the United Kingdom exceeds 200,000 tons per annum.

In dealing with oils obtained from oil-wells or by the distillation of shale or from any other source, there are always certain products which are difficult to dispose of. There is a ready sale for oils distilling below 150° to 160° as motor spirit. Then there is an intermediate fraction from 150° to, say, 300°, which, if it contains chiefly paraffin hydrocarbons, is useful for illuminating purposes, but fetches a much lower price than the lower boiling oil. The employment of this oil, of which there are large quantities, depends upon the amount required for burning in lamps. Since the introduction of the incandescent gas-mantle and electric light, the requirements of oil for burning purposes are much less than formerly, and consequently there is a glut of oils boiling at this particular range of temperature. The next fraction forms the fuel oil; but it must be pointed out that the boiling-point of a fuel oil does not much matter, provided the flash-point is not too low and the viscosity when cooled to 32° F. not too great.

The following are the British Admiralty specifications for oil fuel:—

"The flash-point should not be lower than 175° F. close test (Abel or Pensky-Martens). [In the case of oils of exceptionally low viscosity, such as distillate from shale, the flash-point must not be less than 200° F.]

"The proportion of sulphur contained in the oil shall not exceed 3 per cent.

"The oil fuel supplied shall be as free as possible from acid, and in any case the quantity of acid must not exceed 0·05 per cent., calculated as oleic acid, when tested by shaking up the oil with distilled water, and determining by titration with decinormal alkali the amount of acid extracted by the water, methyl orange being used as indicator.

"The quantity of water delivered with the oil shall not exceed 0·5 per cent.

"The viscosity of the oil supplied shall not exceed 2,000 seconds for an outflow of 50 cubic centimetres at a temperature of 32° F., as determined by Sir Boverton Redwood's Standard Viscometer (Admiralty type for testing oil fuel).

"The oil supplied shall be free from earthy, carbonaceous, or fibrous matter, or other impurities which are likely to choke the burners.

"The oil shall, if required by the Inspecting Officer, be strained by being pumped on discharge from the tanks, or tank steamers, through filters of wire gauze having 16 meshes to the inch.

"The quality and kind of oil supplied shall be fully described. The original source from which the oil has been obtained shall be stated in detail, as well as the treatment to which it has been subjected and the place at which it has been treated.

"The ratio which the oil supplied bears to the original crude oil should also be stated as a percentage."

The minimum flash-points adopted for oil fuel by other navies are:—

Germany	187° F.
France	200° F.
United States	150° F.
Russia	212° F.
Italy	212° F.
Austria	248° F.

The requirements for fuel oils are rapidly increasing, and this is one of the reasons why I have such faith in low-temperature carbonisation,

because a large proportion of the oil produced can be employed as a fuel oil.

Our own Admiralty are employing oil fuel to a greater and greater extent; the policy of the United States is to use oil exclusively as fuel for the battleships, cruisers and torpedo boats. They have now built, or are building, the following vessels which will employ only oil fuel: Four battleships, forty-one destroyers, one monitor, fifty submarines, three tank vessels, three tenders, seven oil barges, and several small vessels and tugs.

Lubricating oils are usually obtained in the higher fractions. Some oils, however, even when they have a high specific gravity, lack the viscosity necessary for use as lubricants, and the problem then arises what to do with them.

Probably these oils might be profitably cracked, and thus be converted into oils of lower gravity and boiling-point.

GROWTH OF THE THREE GREAT FLEMISH PORTS.

The Milanese journal *Il Sole* has recently published an interesting article on the remarkable growth of the three ports of Amsterdam, Rotterdam, and Antwerp. Written by Signor Gino Borgatto, a member of the Naples Chamber of Commerce, who visited these ports only a few weeks previous to the outbreak of the war, this article cannot fail to be read with special interest at the present time.

From their geographical position, Antwerp and Rotterdam are eminently favourably situated for the transhipment trade: the first on the banks of the Scheldt, about sixty miles from the North Sea, and the second on the River Maas, only fifteen miles from its mouth at the Hook of Holland. These ports are in direct communication, by means of the great waterway of the Rhine and the immense network of navigable canals, with the heart of Germany, as well as with the principal industrial and commercial centres of Belgium and Holland.

With such a vast hinterland, and with its splendid natural and artificial advantages, it is not surprising that Antwerp and Rotterdam should have been able, of late years, to secure so large a share of international trade, and so become formidable rivals to the premier port of Germany, namely, Hamburg. One fact common to all three ports is that their increased prosperity is of comparatively recent growth, as it may be said to date from the middle of the nineteenth century.

In 1850 the total number of vessels that entered the Port of Rotterdam was only 1,940, with a tonnage of 346,180 net, of a total of 6,961 vessels and 767,710 tons that entered all the ports of Holland that year.

The gradual increase in the movement of shipping at this port, as compared with that of all the Dutch ports, is shown by the following statement:—

Year.	Port of Rotterdam.		Totals for all Ports of Holland.	
	Number of Vessels.	Net Tonnage.	Number of Vessels.	Net Tonnage.
1860	2,449	592,978	8,714	1,458,894
1870	2,973	1,026,348	8,351	2,037,491
1880	3,456	1,681,650	(No figures given)	
1890	4,535	2,918,400	9,475	5,446,100
1900	7,268	6,326,900	12,037	9,450,700
1905	8,138	8,339,300	13,709	11,738,200
1910	9,338	10,658,800	14,874	13,034,400
1912	10,208	12,094,000	17,000	17,335,900

It will be seen that the tonnage of the vessels which entered this port during the last quarter of a century has increased 414 per cent.

Less striking has been the growth of the port of Amsterdam, the tonnage of which that entered has increased 273·4 per cent. during the last twenty years:—

Year.	Number of Vessels.	Tonnage (Displacement).
1880 . .	1,611	2,980,400
1890	1,575	4,200,000
1900	2,111	7,060,055
1910	2,288	10,074,560
1913	2,597	12,303,055

The shipping returns of the Belgian port of Antwerp plainly show the wonderful growth of the trade of this city since the middle of the last century:—

Year.	Number of Vessels Entered.	Tonnage.
1850	1,406	239,165
1870	3,967	1,362,606
1880	4,475	3,063,825
1890	4,728	4,506,177
1900	5,414	6,720,150
1905	6,094	9,900,305
1910	6,770	12,654,153
1911	6,896	13,849,633
1912	6,973	13,797,000

From this it will be seen that whilst the number of vessels frequenting the port has only increased about 27 per cent., the tonnage entered has more than doubled during the last twelve years.

Compared with some of the other principal ports of Europe, Antwerp and Rotterdam hold important places as regards the tonnage of the vessels that entered in 1912:—

Port.	Number of Vessels.	Total Net Tonnage.
London	23,572	18,745,900
Liverpool . . .	20,868	15,147,100
Antwerp . .	6,973	13,797,000
Rotterdam . . .	10,208	12,094,000
Marseilles . . .	8,246	9,682,300
Naples . . .	10,076	9,377,200
Genoa	6,014	7,105,500
Bremen	5,739	4,210,400

The growing importance of Antwerp as an international port of transit may be estimated from the following figures, which give the value of the goods landed from 1850 to 1911 inclusive:—

Year.	Total Value of Goods Landed.		Value of Goods in Transit.	
	Francs.	£ Sterling.	Francs.	£ Sterling
1850 .	431,900	17,276	201,200	8,048
1870 .	1,600,900	64,036	831,600	33,264
1880 .	2,897,600	115,904	1,008,400	40,336
1890 .	3,109,400	124,376	1,511,100	60,444
1900 .	4,138,600	165,544	1,674,600	66,984
1905 .	5,401,800	216,072	1,922,900	76,916
1910 .	7,672,300	306,892	2,287,200	91,488
1911 .	8,088,800	323,552	2,298,900	91,956

It is estimated that in 1912 no fewer than 136,887 craft of various descriptions, with a carrying capacity of 29 millions of tons, were employed on the inland waterways in connection with these ports.

The following statistics will give some idea of the importance of the three ports as regards facilities for handling merchandise.

Rotterdam has eight floating docks, with a total capacity of 50,672 tons. The total area of the various docks is 269·9 hectares (666½ English acres). Length of quays, 39·8 kilometres (130,544 lineal feet).

The length of the quays at Amsterdam has been nearly doubled during the last twenty years from 4,850 metres (15,908 feet run) in 1892 to 6,220 metres (20,401 feet) in 1902, and 7,040 metres (23,091 feet) in 1912.

At Antwerp, in 1912, the length of the eleven principal quays was 14,941 lineal feet, and that of the sixteen docks 64,118 feet, making a total of 79,059 feet run of quay accommodation at this port.

A KHAKI DYE.

At the present moment, when the demand for khaki is practically unlimited, attention may be directed to a communication by Mr. M. Fort, M.Sc., of the Technical College, Bradford, on "A Method of Developing a Fast Chrome Brown on Wool," which appears in the July number of the *Journal of the Society of Dyers and Colourists*.

Mr. Fort was led to experiment with gallic acid, a simple derivative of natural products, the supply of which is practically unlimited, and the production of which does not compromise the manufacture of explosives in any way. It has been and is being largely used on that account doubtless by dye manufacturers themselves, as it readily gives rufigallol and galloflavin, without the benzoic acid required to make anthragallol.

The scientific basis of the new method lies in the diazotisation of wool, its coupling with gallic acid, and fixation of the dyestuff thus formed by means of chrome. It is a perfectly general method admitting of the use of many phenolic bodies other than gallic acid if and when such are available. Tannic acid itself may be substituted for gallic acid in the process, giving somewhat similar shades but inferior in depth, with the added risk also of depreciating the handle of the wool by making it harsh, such risk being entirely absent when gallic acid is employed.

It is unnecessary to detail the various trials which were made to discover the best method of producing a shade on the basis adopted above. The best method is found to be as follows: Wool is chromed in the ordinary way to produce a green chrome mordant, *e.g.*, 3 per cent. bichrome, 2½ per cent. tartar, or with any other suitable assistant, bisulphite after-treatment, etc., which may be in ordinary use at present for this purpose. The dyebath is made up for dyeing a shade of medium depth with 2 to 3 per cent. gallic acid, 4 per cent. sodium nitrite, and 5 per cent. acetic acid, reckoning on a standard bath thirty times the weight of the wool. The chromed wool is entered cold or lukewarm, the temperature raised to the boil slowly and the bath boiled one hour. The shade develops slowly and evenly with rise in temperature, level dyeing and good penetration being easily assured in the case of either light or

deep shades. At least an hour's boiling is necessary to obtain full fastness by complete fixation of the chrome lake. The bath is not exhausted. The fastness of the shade obtained is good to light, very good to heavy milling, alkalis, and acids. The wool is not deteriorated in tensile strength, handle, milling properties, etc. The shade may be varied by addition of suitable dyes, *e.g*, mordant dyes which are unaffected by nitrous acid.

By the method described above the brightest shades are obtained in wooden vessels, iron causing a dulling of the shade, while copper also exerts some influence on the shade, but to a much less extent. The effect of copper vessels such as are in common use for top dyeing may be overcome by use of copper in mordanting; *e.g.*, 1 or 2 per cent. copper sulphate crystals along with the bichrome. The shade thus obtained is a full brown of yellowish cast, and is faster to light. In a three months' exposure test at similar depths of shade it proved superior to Khaki Brown W. The fastness to light is unimpaired by heavy milling before exposure. This brown, really an ingrain brown on a copper-chrome mordant, is one of the fastest browns known on wool, being very good indeed to all usual agencies. It will be noted that all additions to the dyebath are perfectly soluble, and this allows of use on various kinds of material dyed in special machines.

MACHINERY TRADE IN JAPAN.

Some Interesting Facts and Figures.

The following information on the machinery trade of Japan has been received from H.M. Commercial Attaché at Yokohama.

In the 1913 report on the trade of Japan it was explained that, inasmuch as it takes a long time to obtain delivery in Japan of goods from abroad, the heavy importations of machinery in 1913 were the outcome of the optimistic feeling which prevailed in 1911, and it was shown that, owing to the depression in the business world in 1912, it might safely be anticipated that the machinery figures would show a large falling-off in 1914. This prophecy proved quite correct, for whereas the total for 1913 was £3,752,700, it dropped to £2,500,000 in 1914.

The United Kingdom remains well at the head of the list, and now enjoys more than 50 per cent. of the business, which is better than for a long time past. Although, as explained above, the war was not responsible for the falling-off in the orders placed for machinery to arrive in 1914, it certainly interfered to a considerable extent with the deliveries of German machinery. This can best be gauged by comparing the figures up to the end of July with those for the whole year. Up to the time when war broke out Germany had 25½ per cent. of this business; by December the percentage had dropped to 22. There is still a little more to come forward from Tsingtao and from places where German ships have run for shelter; but when this has all arrived, imports from Germany will cease completely, and British makers will at last have a fair chance of competing, and it is to be hoped they will take full advantage of it.

Since war broke out very few orders have been placed. At first there was an idea that it would be impossible to get delivery; then, when it was seen that this would not be the case, buyers still held off owing to the general uncertainty as to what the future held in store; but confidence is gradually returning, and it is thought that within the next few months it will be possible to obtain a certain amount of orders. There are some points, however, which should be borne in mind. The most important is that Government Departments, in pursuance of the policy of "Support home industries," place their orders in Japan whenever they can possibly do so. Another important factor is that Japanese engineering works are increasing in number and in capacity. Were it not for the heavy import duties it would, of course, be impossible for them to compete in a great many lines; but the duty and the freight rates together give them a big advantage, which enables them to come fairly near British prices.

H.M. Commercial Attaché suggests that makers of small machinery of a class which is sold in quantities in standard sizes, such as gas-engines, electric motors, pneumatic drills, pumps, etc., should send out their goods for sale consigned to firms of high standing. By this means stocks can be kept, and a purchaser who finds that he can buy from stock will be more likely to go to the importer than if he has to wait for eight or nine months for delivery—in the latter case he will be tempted to try a Japanese-made copy of a foreign machine, which he can get quicker and cheaper. The importing firms themselves are rarely willing to tie up their capital in stocks, as the profit they can obtain is often eaten up by local high interest charges, while the manufacturer, who has naturally added a considerable amount to his price for standing charges and profit, would only be paying interest on the actual first net cost, and he would also probably be able to borrow money at a cheaper rate in the United Kingdom. The merchant would keep the bulk of the goods in bond, so that if it should prove necessary to ship them to some other market, this could be done without loss of the duty.

The reason for bringing this suggestion forward is that the manufacture of machinery in Japan is making considerable progress, and unless some thought is given to the problem, United Kingdom manufacturers may loose a part of the business which they now enjoy. It should also be stated that the idea mentioned above has been tried during the past two or three years with, as far as can be learned from the parties concerned, a considerable amount of success.

One of the interesting features of engineering work in Japan is the very large number of tiny

establishments in existence—places which appear in engineering directories as "So and So's Engineering or Iron Works," but which really consist of a workshop with one lathe and two or three employees. They have no establishment charges, they work for a very small profit, and consequently they are able, in tendering for Government work, to put in exceedingly low prices. They do not quote direct- they are too small to do that—but a sort of broker takes the contract from the Arsenal or other Department, and then sublets it to those different works. As they are on such a small scale, there is a good deal of irregularity in the output, and the percentage of rejections is large; but none the less competition from such work is very severe.

Naturally, the above remarks do not apply to the big works, which are run on more or less foreign lines, although, even in these, there are points of difference which immediately strike the foreign engineer. For instance, the foreman is invariably on the side of the men and against the office. Then, again, there are no apprentices, and no men of a better class gaining practical experience by putting in a certain number of years in the works. The engineers are nearly all graduates of technical colleges with little practical experience. The workmen, on the whole, are industrious and eager to learn; but their rice diet appears to be against them, for in engineering jobs they lack the necessary bodily weight, and the percentage of days when they are absent on account of sickness is very high. Nevertheless, as their wages are low and as they are gradually learning and acquiring experience all the time, it is well worth while for any British maker of machinery who supplies either the Japanese or the Chinese market to watch developments, and to change his policy as and when required.

ENGINEERING NOTES.

Recent Developments in Electric Traction.—In the endeavour to find the most economical method of applying electrical energy to the working of railways many systems have been installed. It would be most desirable, on account of junctions and places where companies have running powers over each other's lines, that a uniform system should be adopted in the future; but although the successful results have warranted the conversion from steam working, it has been very difficult to make a final decision as to which of the electrical systems is the most economical, as no two railways which have been electrified present the same conditions as regards distances, density of traffic, etc. The oldest and the most tried is the direct current system used in the Underground and in all tramways in London. More recently high tension direct current has made headway in America, and in Australia, where the Victorian Railway Commissioners have adopted this system. Italy favours the three-phase alternating current system, which, although requiring at least two conducting rails or overhead wires, presents great simplicity in other respects. Lastly, the single-phase alternating current used on the Brighton and South Coast line and many Swiss lines possesses great advantages, in that the current can be transmitted to the train at a high voltage, requiring only a single small overhead wire. The motor equipment, however, is costly and requires a special low frequency, *i.e.*, 15 to 25 cycles per second. The use of a mercury vapour rectifier on the locomotive to convert the single-phase alternating current to uni-directional current is under trial, and would enable direct-current motors and a standard alternating current frequency to be used. In the electrification of the Bluefield to Vivian section of the Norfolk and Western Railway in the United States, an alternative method has been put into operation in which a single-phase supply is converted to three-phase by means of a special rotating converter on the locomotive. It has thus become possible to utilise the special advantages of the three-phase induction motor for heavy traction, whilst retaining the simplicity of the single-phase distribution and collection. This system, which is unique in its application to electric traction, also lends itself to the return of energy to the line when a heavy train is descending a grade.

A Petrol Railway Coach in New Zealand and in the United States.—But there are other ways apart from steam of gaining power for traction, amongst others petrol, and one of these, termed the "Thomas" system, is thus detailed in a *Times* article referring to New Zealand. This plan, which depends on the use of two electrical machines (each about one-third of the normal horse-power of the prime mover), and a planetary gearing interconnecting them with the engine and the load, gives remarkable flexibility of control. Twelve forward speeds are provided; at top speed all the power is transmitted direct mechanically, but for starting or for climbing heavy gradients part is transmitted mechanically and part electrically. The vehicle runs equally well forwards and backwards; the change for continuous working is effected by reversing the direction of rotation of the engine, but when a change of direction is required for short distances, as in shunting, the transmission is effected electrically, one of the electrical machines coupled to the engine acting as a dynamo and driving the second machine, which is coupled permanently to one of the driving axles and acts as a motor. The engine is started electrically by passing the current from a battery through the first electrical machine. Power is supplied by a 200 horse-power engine of the V type made by Messrs. J. Tylor and Sons, London. This has eight cylinders, 7 in. in bore by 8 in. in stroke, and runs normally at 900 revolutions per minute, the maximum being 1,500 revolutions per minute. It is expected that the fuel consumption will be of the order of 200 ton-miles per gallon of petrol.

The vehicle, which is designed chiefly for suburban work, has a maximum speed of just over 40 miles an hour on the level, and is required to carry passengers and haul a 25-ton trailer up a gradient of 1 in 40 at 15 miles an hour, the gross load being then about 60 tons. The coach alone is to mount the gradient at 28 miles an hour, and it is estimated that it will haul a gross load of 85 tons up it at about 10 miles an hour. In ordinary service it will haul 25-ton trailers with a full complement of passengers, about 150 in all. The body is at present not fitted, as it is to be made at the Government railway works in Wellington.

What is said to be the largest petrol motor-car for railway use in the United States has been built by the McKeen Motor Car Co., Omaha, Neb. It is a baggage, mail, express, and power-car, equipped with a 300 horse-power engine which will furnish sufficient power to haul a standard car as a trailer. The engine is reversed by air-pressure mechanism, the control of which, together with the throttle, is placed on the right-hand side of the engine. The length of the car is 70 ft., and the total wheelbase is 44 ft. 2 in. The weight on the drivers is 33,800 lb. and the tractive effort exerted by the engine 8,200 lb. The car is intended for service on one of the branches of the Union Pacific Railway, and will be substituted for a three-car steam passenger train having a seating capacity of 70, whereas it will seat 78 passengers. A round trip of 206 miles a day will be made.

Magnet for Removing Metal from the Flesh.—A strong magnet for lifting weights is not an unusual engineering operation, but it is not customary to enlist a surgical one for the purpose. This is being done by one of the most powerful magnets in the world, and has been installed by the Westinghouse and Electric Manufacturing Company in the relief department of its East Pittsburg works. The magnet is mounted on a box containing the resistor, which is used to regulate the amount of current flowing through the coils. It requires 4,000 watts for its operation, or enough power to supply one hundred lamps of 32 candle-power each, and is designed for operation on 70 volts. It is not an infrequent occurrence for steel and iron workers to get bits of metal in their eyes or hands. Previous to the installation of a magnet the only means of removal was by probing, a method which is as uncertain as it is painful. Since this machine was put in operation, it is a very simple proceeding to extract such particles. The portion of the body in which the foreign particle is embedded is placed near the pole tip of the magnet, the switch is closed, and the magnet does the rest. Some remarkably small pieces have been extracted in this way. The pole piece is removable, a number of different shapes being supplied for various classes of work.

Rail Corrugation.—This is a matter concerning electric traction, in view of which an interesting experiment is being tried on the Huddersfield Corporation tramway system. Mr. R. H. Wilkinson, the general manager and engineer, has devised, the *Engineer* tells us, a differential gearing which has been fitted to eleven of the Huddersfield cars, his view being that by thus endeavouring to eliminate the slip and skid of the wheels the cause of the formation of corrugations will be removed. These eleven cars are running on a section from which the corrugations have been carefully ground out. So far sufficient time has not elapsed for any definite results to be obtained, but it is stated that the indications up to date are of a favourable nature. It had been anticipated that the use of differential gears would have led to some small reduction in the consumption of current, but this economy has not materialised, although, on the other hand, there is evidence of a distinct increase in the life of tyres.

A Flat Long-span Concrete Arch.—An arch of this description was built during the past year over the Aare River at Olton, Switzerland. Its span is 269 ft., and its rise 30 ft. 5 in., giving a ratio of span to rise of 8·8. The bridge is relatively narrow, being only 26 ft. wide between railings. The 16-ft. roadway is designed for 77 lb. per square foot and a waggon of 13 tons weight, while the footways are figured for 110 lb. per square foot. The arch is three-hinged. Its curve was laid out to follow the pressure line. The width of the barrel is 19 ft. 8 in.; the ring thickness is 62 in. maximum (at quarter points), 48 in. minimum (at crown), and 52 in. at skewbacks. The maximum stress in the concrete is somewhat below 700 lb. per square inch. The roadway, a 6-in. slab, is carried by four stringers supported directly on columns resting on the arch. The slab cantilevers out beyond the outer line of stringers to form the footways. Expansion joints in the roadway are provided over the springing line and at the point where the roadway merges into the arch barrel. Load tests under a 16-ton steam roller gave deflections of ⅛ in.

A Small Hydro-Electric Plant.—A small station designed to give satisfactory service to a town consisting of 400 people and at the same time return a reasonable earning on the investment, was recently completed at Waucoma, Iowa. It consists of a concrete dam of the ordinary reverse surge type, 193 ft. long and 12 ft. in height, giving a working head of 9 ft., and a power-house built of vitrified hollow blocks, with a reinforced-concrete floor and a roofing of asbestos shingle. The source of supply is a small, spring-fed stream, which runs through the centre of the town, with an average flow of about 16 cubic ft. per second. For developing the power there is a 20-in. Leffel wheel, directly connected to a 37 kilowatt three-phase, 60 cycle alternating current generator. There is also a 30-in. Leffel wheel belted to a generator shaft and connected with a friction clutch to be used in flood times. The plant was designed with a strict view to maintaining balanced

proportions and to meet with local conditions. Great care was exercised to purchase the correct machinery for the particular purpose. The plant is nearly automatic in operation, and gave a net earning of 10 per cent. during the first month it was operated. Since then the load has been increasing to such an extent that an earning of 15 per cent. is expected for the first full year of operation.

CORRESPONDENCE.

THE VALUE OF BIRDS TO MAN.

In the issue of your *Journal* for June 18th is a reprint of Mr. James Buckland's interesting article on "The Value of Birds to Man," taken from the report of the Smithsonian Institution. In it the following paragraph appears:—

"Those grass ticks which now make the keeping of most breeds of cattle impossible in Jamaica are not mentioned in the records of the early nineteenth century. The appalling destruction in more recent years of insect-eating birds, chiefly to supply the demands of the millinery market, has led to an inordinate increase of the ticks and to the dying out of all but Indian cattle. This correlation of birds and ticks—to say nothing of mosquitoes and other insect plagues in Jamaica —was put fully and circumstantially before the Secretary of State for the Colonies by a deputation in 1909."

Without wishing to imply that the ticks are not a serious handicap to the stock-raiser (or pen-keeper), I think it right to point out that the paragraph contains several statements which are exaggerated. First, it is not true to say that the keeping of most breeds of cattle in Jamaica is impossible. Secondly, it is not true to say that there has been an appalling destruction in more recent years of insect-eating birds, chiefly to supply the demands of the millinery market. Thirdly, it is not true to say that there has been an inordinate increase of ticks in more recent years. Fourthly, it is not true to say that all but Indian cattle are dying out.

The plague of ticks is to be dated to the purchase in the last twenty years of the last century of cattle from Central America, which introduced the blood parasite of tick fever.

The mongoose was introduced from India into Jamaica in 1872, in order to reduce the rats on the sugar estates. This they did, but by 1890 they had become such a nuisance, by reason of their killing of domestic poultry and wild birds, that a Commission of four sat on the subject. Two Commissioners found:—

"That the mongoose destroys young birds, kids, lambs, newly-dropped calves, puppies, kittens, also the young of the coney, poultry of all kinds, game such as partridges, quail, guinea-fowl, snipe, lapwing, ground doves, young John Crows, and all birds which nest on or near the ground, and their eggs; as well as snakes, ground lizards, frogs, turtle and turtle eggs, land crabs, and other useful creatures. We had evidence to show that the mongoose eats ripe bananas, pines, young corn, avocado pears, sweet potatoes, cocoas, yams, pease, and certain fruits, and that he is suspected of sucking the sugar-cane, also that he will eat meat and salt provisions, and can catch fish; in short, that he is, or has become, omnivorous."

The other two Commissioners stated that what was lost in poultry was gained in coffee, corn, and other crops.

As a matter of fact, the mongoose, which has certainly aided the increase of ticks by the destruction of tick-eating birds, does not now appear to be continuing to increase. Indeed, many sanguine people say they are diminishing. There certainly is not, and never has been, any appreciable destruction of insect-eating birds to supply the demands of the millinery market. A few humming-birds may be killed for that purpose, but there is no evidence that skins are exported as a commercial undertaking, and humming-birds' plumage is seldom, if ever, seen in the island as part of female attire. A number of birds are killed yearly by boys with stones, catapults, and various springes, but this is hardly peculiar to Jamaica. A Birds and Fishes Protection Law provides for the protection *throughout the year* of a large number of insect-eating birds; but it is true that this law is not so rigidly enforced as is desirable.

There are by estimate 116,000 horned stock in the island. Perhaps as many as 40 per cent. have not a drop of Indian blood in them, being chiefly of native breed, with admixture in many cases of Shorthorns, Herefords, Devons, Redpolls, and Aberdeen Angus, or dairy breeds. It is true that Indian cattle are much less attacked by ticks than European breeds and the infusion of Indian blood has considerably strengthened and made more resistant to ticks the other breeds; but to say that the latter have died out, or are dying out, is far from the truth.

The question of tick-destruction has, since the visit of Professor Newstead in 1910, received much more attention than it did some years ago, with beneficial results.

Finally, I may quote the opening sentence of a recently published article on "The Improvement of Native Cattle in Jamaica," by the Director of Agriculture: "The island of Jamaica is remarkably suitable for the breeding of cattle, and there are large areas of land where magnificent tropical cattle can be reared under economical conditions."

Kingston, Jamaica, July 29th, 1915. — FRANK CUNDALL.

GENERAL NOTES.

BOOKS FOR BRITISH CIVILIAN PRISONERS OF WAR INTERNED IN GERMANY.—The Board of Education has issued a request for books of an educational character for the use of the British civilian prisoners in the Concentration Camp

at Ruhleben in Germany. The books are needed for use in the educational classes in connection with the Camp Education Department, which has recently been formed for the benefit of the prisoners. The books required deal with English History and Literature, various branches of Science, Navigation, First Aid, Commercial Law, etc. Dictionaries, works of reference, and scientific periodicals would also be most valuable. Any communication on the subject should be addressed to Mr. Albert T. Davies, Board of Education, Whitehall, London, S.W., and he will supply a form on which intending donors can enter the books they are able and willing to give for the purpose. Donations of money are not directly asked for, but will be accepted, and utilised to the necessary extent.

TOURS IN FRANCE.—The Touring Club of France has issued a pamphlet intended to encourage visitors to France at the present time. The pamphlet gives a sketch of various tours which may be made in France, and, judging from its contents, there is no reason why those who are uncertain where to spend their holiday should not arrange to spend it in France.

COTTON INDUSTRY IN MANCHURIA.—In 1911 a company was organised at Mukden with a capital of £300,000 for the manufacture of cotton sheetings. The machinery comprises thirty looms, and the motive power is furnished by kerosene engines. About fifty operatives are employed, and the daily output is 1,200 yards. The same company works a cotton-mill at Liaoyang, which contains a total of twenty-four looms—sixteen for sheetings and eight for nankeens. The production of this mill in 1914 was 6,500 pieces of sheetings and 4,500 pieces of nankeens. A cotton-mill at Newchwang operates twenty power-looms for nankeens and thirty-six hand-looms for sheetings. Last year this mill turned out 11,000 pieces of nankeens and 10,000 pieces of sheetings. The output from these three small establishments is, at present, too insignificant to have any effect on the market; but, says the United States Consul-General at Mukden, it is worth noting as an indication that in time cotton manufacturing in Manchuria may become an industry of importance.

COTTON WASTE IN INDIA.—The war has opened up possibilities of creating several new industries in India. Hitherto, India has exported large quantities of cotton waste to Germany, and it used to fetch as much as Rs. 60 per candy. Since the outbreak of the war the export has ceased, and some of the captains of the mill industry are thinking how best to utilise the cotton waste, the price of which has dropped from Rs. 60 to Rs. 10 per candy. The waste was used in Germany to turn into coarse counts, which were used for manufacturing blankets, carpets, and other such articles. Some of the mill agents are contemplating the importation of waste cotton plants, so as to utilise the waste for the purpose of manufacturing blankets, carpets, etc., in India. It is to be hoped, says the *Times of India*, that this enthusiasm will not die out until somebody has turned to practical account the opportunity of supplanting German goods by those of Swadeshi make.

STERILISATION OF WATER FOR TROOPS.—A method for the sterilisation of water for troops in the field, and also for domestic and industrial purposes generally, has, it is stated by a French journal, been lately perfected by M. Billon Daguerre. This new method consists in the employment of the ultra-violet rays from an electric lamp submerged in the liquid to be purified. It appears from some experiments recently made with Seine water, artificially contaminated, that all disease-spreading germs were completely eliminated by this new process. The apparatus, which can be mounted on an auto-car, is capable of sterilising 10,000 litres (2,200 imperial gallons) per hour, with a current of 4 ampères at a pressure of 85 volts.

PAPER UNIFORMS.—Both Japanese and Russian soldiers are wearing paper clothes. "Kamiko," as paper clothing is called in Japan, is made of the real Japanese paper manufactured from mulberry bark. The paper has little "size" in it, and, though soft and warm, a thin layer of silk wadding is placed between two sheets of the paper, and the whole is quilted. Japanese soldiers realised the value of this kind of clothing when they had to weather a Siberian winter, but its only drawback is that it is not washable. A company in Yokohama is supplying large quantities of paper shirts to the Russian Army. They state, says the American Consul-General at Yokohama, that paper clothes are extensively manufactured in Japan. The garment sold by the firm is made of tough, soft fabric, strong enough to hold buttons sewn on in the ordinary way, and appears to be very serviceable.

NATURAL GAS IN CANADA.—Throughout the entire length of the intercolonial railway of Canada, running from the Atlantic seaboard to Montreal, the passenger cars are lighted with gas from the New Brunswick natural gas-fields, the product having been successfully used in place of the Pintsch gas, with which the lights were formerly charged. Gas is also used exclusively as fuel and for power generation in the car shops at Moncton, over 30,000,000 cubic feet having been consumed in one month, September last. The steady and reliable heat, according to the report of the Canadian Department of Mines, makes it an ideal fuel for forges, furnaces, and gas-engines; no time is wasted in firing up, and there is a considerable saving in expenditure. The gas from the Canadian Pacific Railway well at Medicine Hat is bottled in steel flasks, eight inches in diameter and fifty feet in length, and is shipped for use in lighting the cars. The pressure of the bottled gas is 1,700 lb.

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All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICE.

THE "JOURNAL."

The Fellows will notice that the *Journal* this week appears with a white cover, instead of the usual grey one. This alteration is purely a measure of economy, and is intended to be temporary, for the duration of the war only. As soon as possible the old *Journal* cover will be resumed. The change enables a certain saving to be effected in the cost of printing. In other respects the *Journal* will be precisely the same as heretofore.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

OILS, THEIR PRODUCTION AND MANUFACTURE.

By F. MOLLWO PERKIN, Ph.D., F.I.C., F.C.S., M.Inst.P.T.

Lecture III.—Delivered February 1st, 1915.

It has already been mentioned that when oils, particularly those of high boiling-point, are heated, decomposition takes place and lighter fractions are produced. This peculiarity was first noticed in America, and has since then been made use of for obtaining larger yields of illuminating oils. Oils which boil below 200° C. can be distilled with very little decomposition; those of the paraffin series probably without any. Even with many lighter oils, however, slight decompositions do take place. For example, if an oil distilling up to, say, 170° C. is repeatedly fractionated, residues will be obtained which will require a higher temperature than 170° C. before they will distil over, showing that the heat has produced a change, and on redistillation of the bulk the same phenomenon will be noticed. The action of heat on oils is really either one of decomposition where larger molecules break down into lighter molecules, or in which a shifting of the hydrogen atom takes place, which generally resolves itself into polymerisation and the formation of still higher molecules. The character of the product obtained when an oil is heated depends upon the nature of the oil, the temperature to which it is heated, and the pressure. Generally speaking, when an oil is heated, decomposition and polymerisation take place at the same time. That is to say, if an oil is being cracked in order to obtain a lighter oil of lower specific gravity—for example, to produce a motor spirit—the residue will have a higher specific gravity and boiling-point than the original oil. By gradually heating the residue further quantities of light oil may be obtained, but at the same time a heavier and heavier residual product will result, until finally asphalt is produced, which on further heating decomposes completely and coke results.

Technically, oils are altered in two ways by heating. The first is the cracking process, where the product required is an oil of low boiling-point which can be used for illuminating purposes, or more recently the object has been to obtain a motor spirit. The other process is pyrogenic, in which the oil is heated to a very high temperature, the object being to completely decompose the oil and obtain oil gas. In the cracking process the object is to obtain as little gas as possible.

After the discovery in America in 1861 of the fact that heavy oil, on being heated, produced lighter oil, many attempts were made to increase the quantities of light oil, and many and ingenious inventions were made.

As early as 1850 Vohl had experimented with mineral oil obtained from brown coal and with heavy Canadian and Pennsylvanian oil, and found that by passing the vapours of these oils through red-hot iron tubes which were filled with iron filings or lime, lighter oils were obtained, together with large quantities of gas. The volume of hydrogen in the gas was very small, unless the tubes were heated to a very

high temperature. Vohl went into the matter very carefully and passed hydrocarbons of known formula, which he isolated from the crude oil, through the heated tubes. He decomposed the hydrocarbons $C_{13}H_{28}$, $C_{14}H_{30}$, and $C_{15}H_{32}$, and obtained from these the hydrocarbons C_8H_{18}, C_9H_{20}, and $C_{10}H_{22}$, the yield in every case being about 70 per cent. of the theory. The rest apparently split up into gases such as C_2H_4, C_2H_2, etc. Personally, I am very doubtful as to the yield of these saturated hydrocarbons, because, as a rule, when saturated hydrocarbons are cracked, considerable quantities of unsaturated compounds are produced.

In 1863 Breitenlohner distilled heavy mineral oil and passed the vapour through a red-hot tube. He found that hydrogen was evolved and that carbon was deposited in the tube, showing that he had gone too far in the process of cracking.

In 1871 Thorpe and Young found that by heating paraffin wax under pressure and distilling, fluid hydrocarbons of the methane and olefiant series were obtained. They stated that heating alone, without distillation, did not crack the paraffin wax. On the other hand, Gawalowski has recently (1910) found when paraffin wax, having a melting-point of 45° C., is heated for a long time in an autoclave, that liquid hydrocarbons and gases are produced. The product appears to belong, in the main, to the ethylene and acetylene series, but also contains paraffin and naphthene hydrocarbons.

Friedel and Craft, in 1878, obtained lighter hydrocarbons by heating petroleum oils with aluminium chloride or metallic oxides, such as iron, zinc, or copper; at the same time sulphur was removed. I believe that the experiments were originally carried out with the object of removing sulphur from Canadian oil.

In 1886 Armstrong and Miller obtained, by heating mineral oils to high temperatures, lighter oils, belonging to the olefine, paraffin, and naphthene series.

In 1887 Benton, an American, obtained a patent for "improvements in the methods and means of refining crude and refuse petroleum." In the process, oils were forced under a pressure of 285 lb. or more to the square inch through a series of pipes heated in a furnace, and the products led into a vapour chamber, where the hydrocarbons condensed and lighter oils were obtained.

In 1889, Dewar and Redwood devised an interesting plant for the cracking of oils under high pressure. It consisted of a still and condenser in free communication with each other—that is to say there was no valve between them—the space above the liquid in the still being filled with air, carbon dioxide, or other gas which was pumped in under the desired pressure. The condenser was provided with an outlet by means of which the condensed liquid could be run off. With this apparatus intermediate and heavy oils could be converted into oils suitable for lamps, and also for lighter oils which at that time had not much value except for carburetting gas. It is interesting to note that this process, with very slight modification, has been re-patented in the United States by Mr. Barton, and is being worked on a very large scale. I understand something like 25,000,000 gallons of light oil are being manufactured annually, or at any rate plant capable of doing so has been or is being put down.

Before describing the present-day processes it will be as well to examine the theoretical pinciples which underlie the cracking of oils, at least so far as we at present understand them. All chemical processes of breaking down under the action of high temperature or of condensing or polymerising are difficult to follow; they appear to be partly chemical and partly physical.

From the technical standpoint the object of cracking is to produce, by means of heating, oils of a lower specific gravity, boiling-point and flash-point. Generally speaking, intermediate oils are employed; that is to say, those which are not suitable either for illuminating or lubricating purposes. Raw oils containing asphaltic products are generally not satisfactory, as they block up the tubes of the apparatus with deposits of carbon, and excessive quantities of gas are obtained. Under ordinary conditions, as already mentioned, most hydrocarbon oils, when distilled under normal atmospheric conditions, commence to decompose between temperatures of 200° to 250° C., but with some oils decomposition commences even lower. The boiling-point of the hydrocarbons increases with the number of carbon atoms contained: the larger the chain, therefore, the greater the tendency to break down. For example, in the methane series heptane C_7H_{16} boils at 98° C. and distils without decomposition. On the other hand, pentadecane $C_{15}H_{32}$ distils at 270° C., but is always more or less decomposed. The following are the formulæ for these two substances—

(1) $CH_3.CH_2.CH_2.CH_2.CH_2.CH_2.CH_3$

(2) $CH_3.CH_2.CH_2[CH_2]_9CH_2.CH_2.CH_3$.

Unsaturated hydrocarbons break up much more readily than saturated hydrocarbons. For example, in the olefine series normal heptylene C_7H_{14} boils at 95° without decomposition, but undecylene $C_{11}H_{22}$ decomposes when distilled at atmospheric pressure; to distil it without decomposition it is necessary to distil under reduced pressure. The unsaturated compounds break up where there is a double bond, or in the case of the acetylene series at the treble bond. The position of the bond varies, and may be at the centre of the chain or at the end. For example—

(1) $CH_3.CH_2.CH = CH.CH_2.CH_3$

(2) $CH_2 = CH.CH_2.CH_2.CH_2.CH_3$.

The naphthenes or saturated ring compounds are not so readily decomposed as the olefines; but those which have a four ring are more easily split up than those with a five ring. Thus, (1) will break up at a lower temperature than (2).

$$(1)\ \begin{array}{c} CH_2 - CH_2 \\ | \quad\quad | \\ CH_2 - CH_2 \end{array} \qquad (2)\ \begin{array}{c} CH_2.CH_2 \\ | \\ CH_2.CH_2 \end{array}\!\!>\!CH_2$$

As oils from different localities contain these different hydrocarbons in varying proportions, it follows that cracking processes will require to be modified for dealing with oils from Russia, America, Roumania, etc.

While, however, unsaturated hydrocarbons are more readily decomposed, they also more readily condense together or polymerise to produce heavier hydrocarbons. This may be an advantage or disadvantage. If very light hydrocarbons, particularly gaseous hydrocarbons, condense together, heavier but still light oils may be produced which may be of commercial value. If, however, the heavier oils condense together, asphaltic or resinous products will be obtained. In most cracked oils, products of a more or less siccative nature are produced which require to be eliminated if the oil is to be used for motor engines, because they have a tendency to gum up the valves. These oils appear to belong to the terpene series of hydrocarbons, and when separated form drying oils, which it is said can be used as turpentine substitutes. Their drying properties are, however, doubtful.

In the cracking process the object is to break up hydrocarbons of high molecular weight into hydrocarbons containing fewer carbon atoms. The endeavour is so to carry out the operation that liquid hydrocarbons are produced, and polymerisation and formation of asphaltic products prevented. It may be said that almost invariably small quantities of actual carbon are produced, which means that a small part of the oil is completely decomposed into carbon and hydrogen. It does not follow, however, that any considerable quantity of hydrogen will be found in the uncondensible gases, because a portion of it will unite with the more unsaturated of the oils which have been produced. When very heavy oils are dealt with, carbon formation invariably takes place. If the oils contain phenolic bodies, that is, oxygenated compounds, there is sure to be asphaltic formation, and ultimately carbon deposited. Many crude oils contain considerable quantities of asphalt, and it is very doubtful whether it would ever be a paying proposition to pass them through a cracking process without a previous distillation to remove the asphalt. In doing this, first, the light fractions would be taken off, which would be refined in the usual manner; then the intermediate oils, which would be subjected to cracking; and, finally, the lubricating oils, if they are present, should be worked up separately.

Probably it is not possible to represent by chemical equations the actual reactions which occur when the oils are cracked. There are so many physical conditions which have to be accounted for—temperature, pressure, velocity of reaction and many others, such as difference of heat at different parts of the system. Imagine, for example, a gas passing through a tube the sides of which are heated to 600° C. Those portions in direct contact with the side will be heated to a higher temperature than the central core, and therefore will be more decomposed. Here speed of action will have an appreciable effect. If the vapour of the hydrocarbon is rapidly forced through, the central core may remain only slightly acted upon; if, on the other hand, the progress through the system is slow, gas diffusion may bring all the gas molecules into contact with the heated surface. The difficulty here is that slow rate of speed means small output. The technologist has to consider and ascertain by actual experiment the speed of passage which will give the greatest yield of cracked oil on the original oil employed, also the smallest gas and asphaltic formation.

According to Thorpe and Young, one may suppose that an oil having the formula of $C_{20}H_{42}$—that is, a saturated hydrocarbon—will, on being strongly heated, either at ordinary atmospheric pressure or under increased pressure, split up into C_5H_{12} and $C_{15}H_{30}$, that is, into a molecule

of a saturated and a molecule of an unsaturated hydrocarbon. Thus—

$$C_{20}H_{42} = C_{15}H_{30} + C_5H_{12}.$$

Such a reaction takes no account of hydrogen gas formation, which is invariably produced in greater or less proportions. The actual product obtained is a mixture of several hydrocarbons of the paraffin series, several hydrocarbons of the olefiant series, sometimes acetylenes, also naphthenes, terpenes, and aromatic hydrocarbons.

Suppose that a hydrocarbon of the ethylene series is cracked and splits across the double bond. For example —

$$CH_3.CH_2.CH=CH.CH_3,$$

we shall obtain $CH_3.CH_2.\underset{|}{\overset{|}{C}}H$ and $\underset{|}{\overset{|}{C}}H-CH_3$, two radicals which could not exist alone. There are here several possibilities, *e.g.*, $>CH.CH_3$ may unite with another similar group and form $CH_3.CH=CH.CH_3$, or two of the heavier radicals, $CH_3.CH_2.CH$, may unite together to form $CH_3.CH_2.CH=CH.CH_2.CH_3$, a heavier molecule, or the hydrogen which is produced probably by the decomposition of a hydrocarbon of the methane series will unite with either of these parts and form hydrocarbons of one or other series, thus --

$$CH_3.CH + 2H = CH_3 - CH_3.$$

These few examples will show how difficult it is to build up a theory which will be of use in the practical working out of a cracking process. Undoubtedly decomposition and reunion of different parts of the oil molecule play a very important *rôle* in cracking processes.

There are a variety of cracking processes which are, or have been, worked on a semi-commercial scale, and they all have essential differences, and there seems no reason why several of them should not be worked successfully. In the long run commercial success will rest with the process or processes which can produce a marketable spirit at a low cost. A certain amount of popular prejudice as to the smell of the oil will have to be overcome. Most of the older brands of motor spirit consist in the main of saturated hydrocarbons, but the cracked spirits have a different odour because they contain other hydrocarbons. One often hears of odourless motor spirit: such a product has not yet been obtained, and probably never will be. Most cracked spirits have a higher calorific value, and will therefore give a greater mileage per gallon than the more well-known brands. I believe that there is a great future before motor spirit obtained by cracking processes; but it is essential, if any process is to be a success, that a guaranteed output can be obtained and that the product is always up to sample.

I will now describe some of the more important processes.

In the Noad process, patented in 1909, the oil to be converted and water are sprayed into a heated chamber packed with scrap iron, from which air is excluded. The chamber is heated to a temperature of about 900° F., and it is claimed that the oil and water are vaporised or dissociated in the process in presence of each other and of the highly heated iron which acts as a catalytic agent. The resultant vapours are condensed, and the liquid products so obtained are rectified to separate the volatile spirit.

The proportions of oil and water required to obtain the most satisfactory results are said to depend upon the particular oil under treatment. Thus, for example, with American Solar Oil having a specific gravity of 0·868, two parts of oil and one part of water are used. After rectification the higher products are again passed through the cracking chamber.

This process has been worked upon a commercial scale by the New Motor Spirit Company at Silvertown. Certain difficulties, however, were met with. The oil had a very unpleasant odour which no known method of purification would remove economically. It was also found that the sulphur in the oil acted upon the walls of the cracking chamber and caused them to corrode. For these reasons the process has not turned out a commercial success.

Lamplough's process is based on a somewhat similar principle, the intermingling of water vapour and oil and passage over a heated catalyser. In this case, however, the water vapour and oil are introduced in the form of steam and vaporised oil under considerable pressure, which is maintained while the mixed vapours are in contact with the vaporiser. The catalyser is nickel, and is placed in the cracking tubes in the form of spirals, thereby causing the vapours to take a spiral path through the system; thus greater contact of oil vapour and steam with the catalyser is obtained. The tubes are heated to redness, and it is claimed that the nickel acts as a catalysing agent.

Sabatier has shown that when oil vapours and hydrogen are passed through heated tubes containing reduced nickel, combination takes place, and saturated hydrocarbons can be

obtained from unsaturated hydrocarbons. It is very doubtful whether massive nickel, such as is used in the Lamplough process, will have the same effect. It is more probable that the cracking is produced by the passage of the vapours through hot tubes, which, owing to their form, give long contact with the hot surface. Pressure may also play an important part.

In all cracking processes in which steam and oil vapour are caused to circulate together, the claim seems to be that the water vapour is decomposed into hydrogen and oxygen, and that the hydrogen acts reducingly on the oils which, owing to decomposition (cracking), are in an unsaturated condition. What happens to the oxygen is not explained, but one might expect the formation of phenolic bodies. In the Noad process the oxygen would—supposing the steam to be decomposed—unite with the iron catalyser to form oxide of iron. I doubt, however, whether the temperature employed by Lamplough would be sufficient for the oxygen to react with the nickel. Moreover, as water only decomposes to a very slight extent at 1000° C., and the temperatures employed in these cracking processes are not much above 600° C., if as high, it is extremely doubtful whether water has any effect except to help to carry the oil through the system.

A method of an entirely different nature, in which no water vapour is employed, is that of Mr. Carter White, which is known as the Carter White process. In this process the oil is allowed to drop or is sprayed into tubes which are packed with lime and are heated to a dull red heat, or a higher temperature if desired. The required temperature, it is found, varies with the nature of the oil dealt with. The oil is vaporised and passes in the form of gas through the tubes, which may be horizontal or vertical. As the vapour passes forward it comes in contact with the heated lime, and a portion at least of the vapours actually passes through the pores of the lime. That the vapours pass through the lime can be demonstrated by breaking up the lime blocks which have been removed from the cracking tubes. They are found to be black throughout, that is to say, carbon has been deposited in the pores of the lime, which could only happen by the vaporised oil passing through the material.

Very heavy and crude oils have been experimented with in this process, and from these a light spirit has been obtained. Like most other cracking inventions, the process is designed to work continuously. That is to say, the heavy oil is passed through the tubes in the form of vapour. A portion becomes cracked, and a light oil results. The light oil is distilled off and the heavy residue is again passed through the system, and so on until no oil remains behind. As a matter of fact, the usual practice is to make up the loss with fresh oil so that there may be no break in the operation. One advantage in the employment of lime is that if the oil contains much sulphur a considerable proportion is removed, so that the final product is relatively free from this objectionable impurity. Cracked oils containing even comparatively small quantities of sulphur have an unpleasant garlic-like odour.

In the original process of Valpy and Lucas the heavy oil to be cracked was passed over a heated spiral or grid. The oil was either atomised or introduced in a state of vapour by preheating. The spiral or grid was contained in a tube from the sides of which it was insulated. An electric current was then passed which heated the spiral to any desired temperature, the electric current being regulated accordingly. Apparently the electric heating was difficult, because in a second patent specification it was stated that electrical heating is not necessary.

The method now employed by Lucas is to pass the vapours of oil and water over a granular catalyser. The catalyser consists of an alloy of iron and manganese, a small addition of certain other metals being found advantageous. The catalyser is porous and absorbs oil with great avidity. The plant consists, in the main, of a still for vaporising the oil and the tubes in which the catalyser is contained. Small quantities of steam may be passed in with the oil vapour. It is not claimed that the steam exerts any chemical influence in the cracking. It is indeed stated in the patent specification that the steam appears at the end of the operation as steam or water, and merely acts as a mechanical conveyer.* The oil vapour and steam pass through the tubes containing the catalyser. The oil vapour will, if the catalyser be well packed into the tube, penetrate its porous structure, and here it is claimed that the chief cracking reaction takes place. There appears to be very little deposition of carbon, otherwise the pores would become rapidly closed up; and I understand that the catalyser lasts a very long time without renewal, and that it can

* The use of steam has now been abandoned.

be made active again by heating and burning off any carbon formation. A large number of alloys were tried before the particular one now employed was arrived at, and the method of making it so as to obtain a porous material also required a large amount of experiment.

The Barton process has already been referred to when dealing with the historical aspects of the subject. It is really an adaptation of the Dewar-Redwood patent of 1882. Thirty years ago light spirit was not required as it is to-day. Illuminating and lubricating oils were those which were sought after. Consequently processes, however ingenious, for cracking oils and obtaining very low boiling products were hardly likely to become a commercial success. For vaporising and cracking oils under pressure, the patent of Dewar and Redwood must be considered the master patent, and it is difficult to understand the granting of a patent to Mr. Barton which in all its essentials is similar to the one taken out in 1882. Be that as it may, oil which was a drug on the market is cracked by distilling it at high temperatures under pressure, the still and the condenser both being maintained under the same pressure. This undoubtedly causes the very low unsaturated hydrocarbons to unite together to produce light oils. I understand that the oils themselves are rather too light, but that when mixed with oils that are slightly too heavy a very useful motor spirit is obtained. The process is worked in the United States by the Standard Oil Company.

In the Hall process we have a totally different principle. No catalyser is employed. The distillation is carried out under pressure, and then the pressure of the vaporised oil is released. The Renard process is on still other lines: the actual cracking is done under pressure, and the pressure is of such a degree that the oil during the whole of its passage through the cracking apparatus is kept in the liquid condition—that is, the pressure is kept higher than the vapour tension of the oil at any given pressure.

The plant of the Petrol Process, Ltd., is worked on somewhat similar lines to that of the Renard process. The oil to be cracked is pumped under a pressure of forty to sixty atmospheres through a series of tubes which are heated to a high temperature. The temperature must not, however, be sufficiently high to vaporise the oil, which is kept in the liquid condition throughout the process. After passing through the cracking chamber the hot oil circulates through closed tubes, contained in a boiler, which are surrounded by water. A portion of the heat is here given up, and by keeping a certain head of steam on the boiler the amount of heat given up can be regulated. After passing through the boiler it is suddenly expanded into a chamber and thus becomes vaporised. The chamber is fitted with a dephlegmator, and here various fractions can be drawn off. The oil, stripped of most of the light spirit, is then siphoned into a still fitted with a steam coil where any remaining spirit is distilled off. The gases are scrubbed and then led under the cracking chamber where they are burnt. The unchanged oil is passed back to the storage tank and again circulated through the system, the loss from conversion being made up with fresh oil.

In the Hall process the oil is passed through coiled iron tubes, which are heated to a temperature of about 600° C. This temperature, being much above the boiling-point of the oil, causes a pressure within the system. The oil is continually pumped against this pressure. The hot vapour is held back by means of a check valve. Here it is allowed to pass into a tube, from which the vapours are caused to impinge against a baffle plate contained in an iron cylinder 12 to 16 in. in diameter and about 12 ft. high. This is the actual cracking chamber. So much heat is developed at this stage that the oil becomes cracked. It is then allowed to pass slowly up the chamber, and then through two or more dephlegmators.

When the oil decomposes, or cracks, a certain quantity of free carbon is produced, which ordinarily is very difficult to remove from the oil vapour. The cracking chamber above the baffle plate is packed with pieces of iron tube about 1 to 1½ in. long. These present a very large surface, and the carbon deposits on them in a nodular form. From heavy oils containing much asphalt very much more carbon is produced than from lighter oils, such as solar oil.

The oil is circulated very rapidly through the heated tubes, and when the pressure is released at the check valve the vapour which is produced passes forward at great velocity and strikes the baffle plate with great force, the velocity being immediately brought to zero. The temperature here rises considerably, and this points to an endothermic chemical reaction, because when a gas expands lowering of temperature is the general rule. To a certain extent the oil is completely decomposed, and carbon is produced which adheres to the iron tubes already mentioned. The bulk of the oil is broken down into lower boiling fractions and a portion passes

forward unchanged. The heavy oil is separated by the dephlegmators which are not water-cooled. The light oil and gases pass forward through a settling chamber which removes any entrained oil, and then to the compression pump. The gases and light fractions are here subjected to compression. At this stage a further chemical action appears to take place, which is evidenced by the increase in volume of the liquid. That actual union of the gases with the light fractions, or of the gases with one another to form liquids, takes place is shown by the fact that on fractionation very little gas is evolved. This shows that it is not a question of gas solution in the light oil, but actual conversion of the gas hydrocarbons into liquid hydrocarbons. The spirit can, in fact, be several times redistilled without alteration in boiling-point. This would not be the case if it contained gas in solution.

Light oils obtained by the cracking process always require a certain amount of refining by treatment in the usual way with sulphuric acid and alkali. They generally contain small quantities of turpene-like bodies which are of a siccative nature. If these are not removed they cause gumming in the valves of the automobile engines. Owing to cracked oils containing larger quantities of unsaturated hydrocarbons, and therefore having a higher carbon content than uncracked oils, the calorific value is slightly higher than natural light oils, and consequently the mileage per gallon of spirit is also a little higher.

Cracked spirits have a different odour from natural spirits, and for this reason there has been rather a prejudice against them. It is not that the smell is unpleasant, but that it is different to that which the public has been accustomed to. When, however, these oils are manufactured on a larger scale, no doubt this prejudice will die down, and there appears to be a great future for cracked oils.

The problem of satisfactorily cracking oils to produce light spirit has been worked at for many years, and the difficulties have one by one been surmounted, so that at present there are several processes which may be said to have solved the difficult problem.

BIG CREEK HYDROELECTRIC WORKS.

The Big Creek, a tributary of the San Joaquin River, is a mountain torrent that dashes down the Sierra Nevadas about seventy miles east of Fresno, California. So precipitous is its course that it drops some 4,000 ft. in six miles; and it carries a copious supply of water, as it drains a basin of 88 square miles, which, with an annual rainfall of more than 80 in., gives a run-off of 50 in. With a plentiful supply ensured and an enormous head, conditions are ideal for the generation of electricity.

A Government permit has been granted to the Pacific Light and Power Company of Los Angeles to develop the power of Big Creek, and some particulars of the enterprise have been given to the *Scientific American* by the Stone and Webster Construction Company, the engineers of the undertaking. Twelve years were allowed for the completion of the work. But with great enterprise the company set a record for rapid work in completing the initial development inside of two years. The first work was to build a railroad fifty-six miles long to reach the site of the development. This road was finished and equipped in 157 days. Then three concrete dams were constructed to close gaps between the ridges bounding the basin in the mountains, thus making the reservoir 7,000 ft. above the sea, four and a half miles long by half a mile wide, with a capacity of about 53,000 acre-feet. The capacity will later be increased to 120,000 acre-feet by raising the dams 50 ft. higher.

The fall of 4,000 ft. has been utilised by leading the water through a tunnel and steel pipe lines to the first power-house half-way down, and then through another tunnel and series of conduits to the second power-house. Driven by this mighty head, the water rushes out of the 6-in. nozzles at the power-house with a velocity of 350 ft. per second, which is about 240 miles per hour. The jets dash across an open space of a few inches and then strike the buckets of the impulse wheels, which spin round as fast as the drivers of an express locomotive travelling 100 miles per hour. These wheels are 94 in. in diameter and are arranged in pairs, each pair developing 23,500 horse-power. Despite the enormous velocity of the jet, there is no shock at the impact with the water wheel, because the part of the bucket first touched is nearly parallel with the jet.

After passing through the first power-house the water discharges into the creek. But the creek is here blocked by another dam, and the water is diverted through a second tunnel four miles long into a second series of steel conduits leading to the second power-house.

In each power-house there are two main generators of 17,500 kilowatts capacity each. Here the current is generated at 6,600 volts and raised by transformers to 150,000 volts. The current is carried to Los Angeles, 240 miles away. Two lines of steel towers on a right of way 150 ft. wide will carry six cables, an inch in diameter, from the two power-stations to a sub-station at Eagle Rock, in the suburbs of Los Angeles.

In less than a year and a half after the work at Big Creek was begun both power-stations and one transmission line were in operation, and current generated at Big Creek was in commercial use at

Los Angeles. This involved the setting of more than 3,000 steel towers over the mountains and across the desert and the stringing of nearly 5,000,000 lb. of aluminium cable. It is interesting to note that, by virtue of the great elevation of the reservoir above the two power-plants, every cubic yard of water it contains is worth from 10 to 20 lb. of coal to generate one horse-power in a steam-plant. When the full possibilities of the Big Creek development are realised it will form an inexhaustible mine of energy with an output that could not be equalled by the consumption of over eight million tons of coal per year in a very efficient power-plant.

RUSSIAN COTTON CROP OF 1914-15.

According to a report by the U.S. Consul-General at Moscow, a bulletin issued by the Russian Central Cotton Committee contains the following estimate of the area sown to cotton and the production of pure fibre in Central Asia and Transcaucasia for 1914–15, with comparative figures for the preceding season:—

District.	1913 14.	1914-15.	Production.	
	Acres.	Acres.	Bales of 500 lb.	Bales of 500 lb.
Ferghana	739,473	776,011	548,994	607,515
Samarkand	85,429	96,369	68,826	72,200
Bokhara	177,540	177,540	105,152	119,163
Transcaspia	122,965	151,740	62,759	69,765
Khiva	69,940	69,940	49.593	46,943
Syr-Daria (not including Amu-Daria)	182,428	198,831	80,670	88,686
Erivan Province	102,220	107,600	49,555	43,330
Elizavetpol	134,500	142,570	47,305	45,934
Baku	53,800	75,320	12,345	25,277
Tiflis	13,450	14,795	4,226	5,778
Kutais	5,380	5,380	722	1,084
Total	1,687,125	1,816,096	1,030,147	1,125,675

Of the 607,515 bales of cotton harvested in the Ferghana district, about 70 per cent. will probably be first grade, 15 per cent. "minus," 10 per cent. medium, and only 5 per cent. of the second and third grades. The total crop of clean fibre in Turkestan is estimated at 1,004,272 bales, against 915,994 bales obtained in 1913–14, an increase of about 10 per cent. The crop of cotton fibre in Transcaucasia is expected to amount to 121,403 bales, as compared with 114,153 bales in 1913-14.

The Central Cotton Committee expresses the opinion that the probable crop of Russian cotton cannot but have a reassuring influence on the cotton manufacturing industry at this time of urgent need of raw material. The committee calculates that on September 1st, 1914, the supplies of cotton in the country amounted to 433,520 bales, and 144,400 bales were imported from Asia (Persia, etc.). If to this quantity be added the 1,125,675 bales of cotton produced in Central Asia, the total amounts to 1,703,595 bales. Calculating that the total consumption of cotton in Russia (excluding the Lodz district) does not exceed 1,444,000 to 1,516,600 bales of fibre per annum, the committee believes that the Russian factories will not have to be closed, even if no shipments of American cotton should be received until September 1st.

IRRIGATION IN INDIA.

The official review of irrigation in India during the year 1913-14 has recently been published. The interest earned in the case of "productive" canals was nearly 9¼ per cent., the acreage irrigated being 16,320,000. Minor works for which capital and revenue accounts are kept earned 4·39 per cent., and even purely protective works 1 per cent. As the last-named only serve about half a million acres they are not of much account. It is in connection with the value of crops raised on irrigated areas that the full benefits of the canals are seen; that value was 8½ crores of rupees, the bulk being of course in the Punjab (2,645 lakhs), with 1,831 lakhs in Madras and 1,590 lakhs in the United

Provinces. In the years to come the Punjab will show much bigger figures, as the triple canal project has practically been finished; and in the other two provinces also there will be expansion as new works are being undertaken on a large scale. The Punjab must always remain the premier province in the matter of canals, as it has already between seven and eight million acres under irrigation, and the return on capital is over 15 per cent. In 1913-14 the Lower Chenab Canal had a net revenue which gave over 42 per cent. on capital outlay, the Lower Jhelum Canal coming next with nearly 21 per cent. Madras has the satisfaction of getting a return of 13¼ per cent., but the United Provinces have to be content with just over 8 per cent., and Sind with about 5½ per cent. on productive works. The year under review was marked by intense drought in the United Provinces, both in the *kharif* and the *rabi*, and the resources of the canals were taxed to the utmost. They could not be closed as the demand was continuous throughout the year. Nearly a million acres more than the annual acreage were irrigated, and it became clear that in Bundelkhand the existing sources of water-supply were quite insufficient to meet requirements in seasons of drought. The necessity for additional storage for the Betwa, Dhasan and Ken canals is dwelt upon in the official review. The lesson learned from the drought of 1913 14 cannot be ignored; it is now known that when the monsoon gives fitful and deficient rainfall, and the winter rains are also in defect, the three canals mentioned cannot save the crops in the areas which they serve. Increase in storage is needed, and this improvement must be made before the recurrence of another drought.

TRADE OF THE STRAITS SETTLEMENTS.

By G. d'Almeida.

The "Appendices to the Report on the Trade of the Colony for the year of 1914" contain some most interesting figures on the oversea and internal trade of the Colony and adjoining States, from which it appears that, notwithstanding the disruption of business generally, the Colony has not suffered as much as might have been expected under the circumstances.

Thus during the year of 1914 the grand total of exports of the Straits Settlements amounted to $334,126,020, against $388,929,705 during 1913. This shows a falling-off of $54,803,685, or £6,393,763. The imports during 1914 were $391,373,123, or £45,660,197. The decrease amounts to $88,082,355. In imports the Colony totalled $391,373,123 in 1914, on which the various parts of this Colony share as follows: Singapore, $280,430,001; Penang, $106,739,526; Malacca, $3,433,381; Labuan, $639,215; and Christmas Island, $131,000 = $391,373,123. Textile goods imported amounted to $34,493,442, against $48,592,077 for the previous year. Metal values totalled $13,521,492, and miscellaneous goods reached the figure of $19,278,093, against $24,834,869 for the past year. The total value of imports into the Colony was thus $375,907,564 in 1914, against $454,376,239 during the year 1913. This applies to manufactured or partly manufactured goods.

In raw materials the local trade also showed a decrease in volume and value. The total for 1913 amounted to $188,333,981, against a sum of $156,364,785 for the period under review. This latter figure is composed of textiles, $807,510; metals, $81,566,907, and other goods, $73,990,368. Last year's figures were: Textiles, $1,620,986; metals, $109,229,606, and $77,483,389 for miscellaneous goods. These figures cover foreign imports only.

Imports.

The effects of the war are also noticeable in the export trade figures, which show a total of $331,126,020, against the 1913 figure of $388,929,705. These totals for 1914 are computed from the following. Live animals, foods, drink, and narcotics, $117,634,888 ($132,908,249 for 1913). Raw materials: Textiles, $667 071 ($1,485,902 for 1913); metals, $86,201,194 ($83,627,497 for 1913). Total, $172,880,770 ($198,851,404 for 1913). As far as the manufactured goods are concerned the figures work out as follows:—

Textiles	1913 . .	$19,961,206
	1914 . .	$16,716,856
Metals	1913 . .	$6,489,790
	1914 . .	$5.542,338
Other	1913 . .	$14,732,619
	1914 . .	$13,214,034
Total	1913 . .	$41,183,615
	1914 . .	$35,473,228

Coin and bullion were exported to the total value of $8,137,134, against $15,986,437 in 1913.

The total trade with the various portions of the Colony by rail amounted to: Imports, $17,948,000, against $13,421,000 for the previous year; exports: 1914, $9,835,000; 1913, $11,324,000.

Australia and New Zealand.

The total value of the exports to Australia and New Zealand was $1,600,000 in 1914, while the imports totalled $8,081,000 during the year. This also shows a drop, the 1913 figures being $1,853,000 and $735,000 respectively.

British India and Burma.

The imports during 1914 totalled $34,276,000, against $48,813,000 for the previous year. Exports show the following figures: $16,270,000 for 1914, against $17,746,000 for the past year.

Japan.

Our trade with Japan shows only a slight decrease during the past year. The imports were well maintained with $12,092,000, against $12,898,000 during the previous year; the exports to the Island Empire, however, dropped from $5,429,000 in 1913 to $3,517,000 in 1914.

SIAM.

There is an increase in the value of padi and rice, the amount of value of the former being $1,754,000 in 1914, against $1,273,000 in 1913; and for rice, $25,846,000 in 1914, against $24,538,000 in 1913. Otherwise there has been a general decline both in export and import items.

FEDERATED MALAY STATES.

The Federated Malay States have also experienced a falling-off in import and export values—in fact, the total export and import figures have decreased to the amount of the 1911 figures.

There has been an increase of copra export ($1,369,000 in 1913 to $1,797,000) in the period under review; but against this there was a falling-off in import values. The imports for 1913 totalled $101,231,000, against $78,535,000 for the year under review. There was a decrease of $22,696,000 in imports, and a falling-off in the value of exports of $11,854,000.

NETHERLANDS INDIES.

For the year under review a total of $57,426,000 was reached for import values, while the exports dropped to $45,531,000 for the year 1914. The figures of 1913 show sums of $69,638,000 and $49,427,000 respectively. The decrease has largely been due to the restrictions in the export of sugar ($10,381,000 for 1913 to $7,600,000 for 1914) and rattan ($4,164,000 for 1913 to $2,243,000 for 1914), rubber, gutta-percha, and jelutong having also fallen considerably. The decline in values in the Netherlands Indies trade is general, there not being a single commodity of importance which has maintained its previous year's figure. Owing to the war, manufactured goods have been showing only nominal increases.

HONG-KONG AND CHINA.

From a total of $39,888,000 in 1913, import values fell to $32,130,000 in 1914, while the export figures also show an important decline from $15,195,000 in 1913 to $10,770,000 for the period under review. A large decline in the figures of sugar ($1,584,000 to $215,000) is the only notable drop in the figures of import and export, the falling-off being general. The total decreases of our trade with China and Hong-Kong are: Imports, $7,758,000; exports, $4,425,000.

INDO-CHINA.

Both imports and exports from this Colony have been maintained on a fairly normal level. Imports are valued at $16,510,000 for 1914, against $14,959,000 for 1913, this being an increase of $1,551,000. The exports show $2,157,000 ($2,917,000 for 1913), a decrease of $760,000 for the year. The increases are in rice, cattle, and sugar.

MALAY PENINSULA.

Johore, Kelantan, Trengganu, and Kedah.

These States have fairly well maintained their trade, the total combined figures having dropped only from $29,255,000 in 1913 to $28,562,000 in 1914. The Para rubber figures show an increase of $2,415,000 (from $2,227,000 in 1913 to $4,642,000 in 1914). In the export figures there are but slight variations from last year's figures, though there was a general decline.

BRITISH NORTH BORNEO AND SARAWAK.

Exports for 1914 were $4,606,000, against $5,860,000 for 1913, a decrease of $1,687,000 (1913), $5,718,000, a decrease of $1,031,000. Here also the figures show that the falling-off in exports and imports has been general.

When the whole of the Colony's trade during the past year is considered it must be admitted that, notwithstanding this disastrous war, the Colony has well maintained its place in the world's markets.

ARTS AND CRAFTS.

National Competition in War-time.—It is remarkable how little effect the war seems to have had on the quantity and the quality of the works sent up for National Competition. It comes at first as somewhat of a shock to see how much this year's exhibition resembles those of previous years. An examination of the labels attached to the exhibits, however, shows that the great majority of the male exhibitors are engaged in some definitely useful trade or craft, and are not art students by profession, whilst the catalogue reveals how large a proportion of the successful students are women. Again, in certain sections, notably metalwork, there is a considerable falling-off in the number of works sent up. It is, perhaps, to be regretted that in some respects, at any rate, the war has not made more difference to the competition. It would obviously be a bad thing for art education to be in any way curtailed, especially at a time when our enemies are also our great commercial rivals and we have to be ready to show ourselves masters not only in arms but in more peaceful arts. On the other hand, we are face to face with a great national crisis; we are spending liberally and lavishly on those things which are for the moment essential to our national well-being, if not to our existence as a nation, and it seems highly improbable that in anything approaching to the near future the country will have much money to spend on anything but necessities; yet both the works exhibited and the reports of the examiners go to prove that the art schools of the country, and the students who fill them, are still very largely occupied with the production of luxuries.

The various exhibitions held in London and elsewhere, under the auspices of the Board of Trade, have demonstrated, at any rate, the important part which design plays in manufacture and commerce—even from the strictly utilitarian point of view—in ordinary times and under normal conditions. The demands of expenditure for national purposes will probably increase to such proportions that the majority of those who under

ordinary circumstances could afford hand-made and expensive goods will have to content themselves with manufactured articles. It seems as though, in the years that are coming, if industrial art is to flourish at all, if it is to be able to make its appeal to any substantial number of people, if it is to have any real influence, it must perforce express itself mainly through manufacture. And yet over and over again we hear the same tale. The designs for wallpapers are so poor that the highest award the examiners can see their way to make is a book prize. In woven textiles they regret that "they are not able to report an improvement in the standard of work." In damasks "the standard of merit . . . is not so high as that of last year," and these adverse criticisms on large classes of work are by no means compensated by slight improvements in such relatively small sections as carpets and linoleum. Of the seven gold medals only one is awarded for an object to be reproduced by any mechanical or manufacturing process, and that is for a "lace flounce"; while of the fifty-four silver medals only ten, on the most liberal computation, go to designs for reproduction or for any kind of manufacture.

This is a position of affairs which appears to go to show a want of recognition of the needs of the moment. It would be wrong, of course, to allow crafts in which we as a nation excel to languish unnecessarily—they are bound at times like this to be in more or less evil case—but for the moment and in the immediate future, at any rate, our best energies in the domain of art ought to be directed towards increasing our industrial efficiency. We have of late been producing craftsmen rather than designers; if after the war there is any demand for highly trained art workers at all, it will be for designers rather than for craftsmen, and it is to be regretted that the best and cleverest of our students seem still to be turning their eyes in the direction of individual self-expression rather than towards providing tasteful and beautiful things to be used by the greatest possible number of their fellow-countrymen.

It is, however, cheering to see that the designs for pottery, tiles, etc., are better this year than usual. Pottery is one of our large export industries which we may hope will flourish with renewed vigour when the war is over. Further, it must be remembered that the work of the schools was in large measure planned last year before the war broke out, and readjustment takes time. It is to be hoped that in the coming session design will absorb the energies of the larger proportion of the students.

Studies, Designs, and Various Crafts at National Competition.—If we turn to the several subjects, we find that as usual there are some discrepancies in the awards and that certain groups of examiners have been far more generous than others in distributing medals, prizes, and commendations. It really is a pity that no general revision of the successful works as a whole is attempted, for it is impossible to expect small committees of men acting independently to set before themselves exactly the same standard, whilst if they saw the prize designs of their own section exhibited along with those of other groups, they would perceive at once that there had been some difference in their demands.

Of the subjects more or less preparatory to design it is worth noticing that the studies in historic ornament were on the whole carefully and intelligently chosen for their purpose, but the examiners complain that "some studies . . . suffer from an over-elaboration of painting in useless imitation of what may be called still-life effect," and even some of those to which awards have been made are not as directly and simply treated as they might have been. The studies from nature in preparation for design also reached quite a good level, but the "flower and three designs," which ought to indicate that students know how to use their studies when they have made them, were not only few in quantity, but also bad in quality.

The lettering on the whole is very satisfactory and shows distinct improvement, the typography is adequate and the illumination, though there is nothing of very conspicuous merit, reaches as a whole a sufficiently high level. The tooled bookbindings are rather better than last year, and candidates have at length been found to send in designs for publishers' cases—certainly a step in the right direction. Book illustrations reached much the same standard as usual. Some good lithographic studies were sent up, whilst the posters as a whole were satisfactory—though the examiners report a falling-off in the colour-prints. The designs for glassware are more suited to useful purposes than they have sometimes been. The stained glass as a whole is on right lines, and the design which gained a silver medal exhibited a certain amount of originality as well as a knowledge of glass technique. The jewellery is good both in execution and design, and the enamelling generally shows improvement. Some of the cloisonné from Dublin is really excellent. The embroidery is not on the whole very remarkable, but there is some quite good work, some of which might, perhaps, with justice have received rather more recognition than it has done. The designs for machine-made lace are highly commended by the examiners, and in many cases show far greater regard for artistic treatment than this type of work has generally done in the past. The wood-carving reaches a rather higher standard than usual, and the frame from Manchester to which a gold medal was awarded is a really distinguished piece of work, fresh and dignified in treatment, paying due regard to tradition, but allowing the executant's own personality to appear. Some of the stained wood and gesso is also very good, but one rather wonders how far there is an opening for any large quantity of this kind of work, which has of recent years become quite a feature of the exhibition.

On the whole, this year's show is not only as satisfactory as could have been expected under the circumstances, but not appreciably behind those of more propitious years.

The Exhibition at the Royal College of Art.—Unlike the National Competition, the exhibition of students' work held at the Royal College of Art shows signs of having suffered very considerably from the war. This is easily accounted for by the fact that normally the people who are working at the college are students in the more restricted sense of the term—men and women who are giving their whole time to study—and men in this case have very naturally and rightly responded in large numbers to their country's call. The exhibition cannot, therefore, be judged as a representative collection of the works of the students as a whole: it only shows what has been done by the women and by those men who, for some reason or other, have not joined the army. The students who did such good stained-glass work last year are in His Majesty's forces, and the sculpture, decorative painting, design, etching, and, in fact, nearly all the departments of the college, have suffered—as they ought to have done—from the diminished numbers. It is, however, fair to add that in those crafts, such as embroidery and the design for hangings of various kinds, in which as a rule most of the students are women, the work does not reach quite so high a level of accomplishment as one is justified in expecting of a school of practically university rank.

GENERAL NOTES.

Coal Output of China.—According to the "National Review of China," as a result of a recent investigation, the annual output of coal in the provinces of China is estimated as follows:—

Province.	Output.
Chihli	2,164,000 tons.
Shansi	2,500,000 ,,
Shantung	933,000 ,,
Honan	900,000 ,,
Hupeh	100,000 ,,
Hunan	400,000 ,,
Szechwan	300,000 ,,
Anhui	60,000 ,,
Shensi	50,000 ,,
Kansu	50,000 ,,
Kwangtung	50,000 ,,
Yunnan	30,000 ,,

A New Sewage Treatment.—A novel system of sewage treatment is described by Dr. E. Howard Tripp in the *Journal of the Chemical Society*. The Dickson centrifuge process of separating solids from sludge consists in treating it with 0·5 per cent. of yeast for twenty-four hours at 33° C. Anaerobic fermentation sets free the gases, and the solids rise to the surface, from which they are run off. Brewers' yeast is the most effective agent, but dextrose, starch and certain other substances produce similar results. The sludge is then completely dried by exposure to hot air. The dried material contains 3 per cent. of nitrogen and 50 per cent. of organic matter, and possesses valuable properties as a fertiliser. The centrifuge treatment consists in passing the effluents through a centrifugal machine, the perimeter of which is perforated and covered with a layer of sand. As it passes through the interstices of the sand, a bad effluent is completely oxidised and supersaturated with oxygen; if it be further treated in a small contact bed and again centrifuged, the purification, both chemical and bacteriological, appears to be complete.

"Calorising" Coating Iron and Steel.—It is reported that in the Research Laboratory of the General Electric Company of New York, a new process for placing a protective coating on iron, steel, and other metals has been devised. This is for use especially under high temperature conditions. Calorising, the name given to his discovery by Mr. T. Van Allen, consists of heating metals in revolving drums with mixtures containing, among other things, finely divided aluminium, so that a surface alloy containing aluminium is produced. In the case of copper, this alloy is of the nature of an aluminium bronze, but richer in aluminium than the ordinary alloy of that name and more resistant to heat, so that copper thus treated is protected, up to the melting period of the alloy, from the scaling which occurs when untreated copper is heated above 300° C. The same general result is obtained in the case of iron and steel. Pieces which, because of their shape or size, are not adapted for tumbling, may be calorised by packing them in, or painting them with, a suitable mixture and heating them. There are many places where it is desirable to use iron vessels or apparatus at temperatures above red heat, and at such temperatures untreated iron rapidly oxidises and scales away. After iron is calorised the effect of heating is slight.—*Page's Engineering Weekly*.

Trade in Human Hair.—Owing to the discarding of queues among the male population of Canton and surrounding districts there is, of course, not the same quantity or quality of hair to be had as in previous years. And even though the supply of female hair can be had still, exporters are not inclined to go into the business seriously, because so many small dealers have entered into the trade. It is reported that one or two foreign firms have suffered severely as a result of claims growing out of the fact that the quality has deteriorated so enormously. The export in 1914 was 859,333 lb., valued at $124,117, as against 1,590,933 lb., valued at $356,662 in 1913.

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FRIDAY, SEPTEMBER 3, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICE.

PETER LE NEVE FOSTER PRIZE.

Mr. Reginald Le Neve Foster has presented the Society with a donation of £140 for the purpose of founding a prize in commemoration of his father, Mr. Peter Le Neve Foster, who was Secretary of the Society from 1853 to 1879.

The Council have determined to offer the prize for a paper on "Zinc, its Production and Industrial Applications."

The prize will consist of a sum of £10 and the Society's Silver Medal.

The paper for which the prize is awarded will be read at one of the Ordinary Meetings of the Society.

It is expected that some account will be given of the history of the metal, the sources of its supply, its metallurgy, and the various uses to which it has been, or may be, applied.

Intending competitors should send in their papers not later than December 31st, 1915, to the Secretary of the Royal Society of Arts, Adelphi, London, W.C.

The paper must be type-written. It may be sent in under the author's name, or under a motto, accompanied by a sealed envelope enclosing the name, as preferred.

The judges will be appointed by the Council.

The Council reserve the right of withholding the prize or of awarding a smaller prize or smaller prizes, if in the opinion of the judges nothing deserving the full award is sent in.

PROCEEDINGS OF THE SOCIETY.

SPECIAL WAR LECTURE.

FIELD TELEPHONES.

By Charles R. Darling, A.R.C.Sc.I., F.I.C.

Delivered July 28th, 1915.

Ninety years ago, in 1825, William Sturgeon, a retired gunner of the Royal Artillery, received from this Society a silver medal and a grant of thirty guineas for his invention of the electro-magnet.* To-day, in this greatest of all wars, the combatants on both sides find that the telephone, an instrument based upon Sturgeon's discovery, is an indispensable adjunct in the conduct of operations in the field. By its aid communication is established between the various units, guns are fired according to orders conveyed by telephone from the battery observer, and in nearly all cases where it is necessary to keep two or more stations in touch the telephone is used. Flag signalling, being too conspicuous, has practically been abolished: and the present war has rightly been termed a "telephone war."

The telephones to which we are accustomed in civil life are unsuited to military operations for two reasons. Firstly, they lack portability; and, secondly, they are not provided with a means of transmitting messages by Morse code in the event of speech being inaudible. It has therefore been necessary to design special instruments for use in the field, and it is to a description of these, and the methods of using them, that the present lecture will be devoted.

Circuit of Field Telephones.

The usual arrangement of parts in field telephones follows on the lines indicated in Fig. 1. The primary circuit consists of a battery, B, connected to the primary winding of an induction coil, P, and to the vibrator or buzzer, V, through the key, V.K. The microphone or transmitter, M, is placed in parallel with the buzzer, and may be brought into the circuit by means of the key, M.K. The secondary circuit consists of the receiver, R, one end of which is connected to line and the other end to the secondary winding, S, of the induction coil, which in turn is joined to earth through a condenser, C. The arrangement at the other end

* *Transactions*, Vol. XLIII. p. 37.

of the line is identical with the foregoing, and to establish communication the operator at either end connects the line to the terminal L, and attaches the terminal E to an earth-pin through S. This current, on passing through the distant receiver, causes a disc to vibrate and reproduce the original sound. It will be noted that the near receiver, being in the line

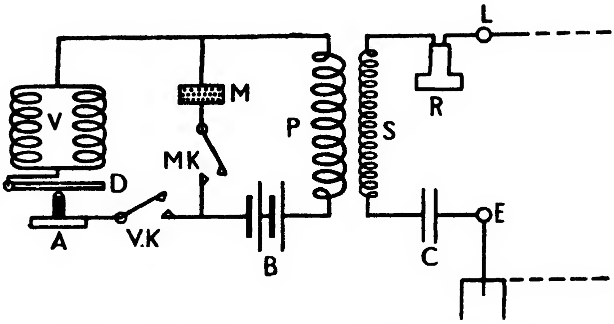

FIG. 1.—TYPICAL CIRCUIT OF FIELD TELEPHONE.

driven into the ground. In different forms of field telephones this circuit is modified in various ways. Most modern instruments possess a third terminal, placed between the condenser and the secondary winding of the induction coil, so that the condenser may be cut out or brought into the circuit as desired. In the Stevens telephone the induction coil serves to operate the buzzer: in the Service instrument, known as the "D Mark III," the buzzer windings perform the functions of the induction coil, and a second receiver, inserted in parallel with the first, is provided. The circuit shown in Fig. 1 may, however, be regarded as the fundamental type upon which the others are based.

Before proceeding to the description of the component parts, the working principle of the telephone may be considered in relation to this typical circuit. When the buzzer is worked, or when a sound wave impinges on the microphone, the current through the primary coil, P, is continually changing in strength. This causes induced currents to be set up in the secondary coil, S, the direction of which depends upon whether the current through P is increasing or decreasing; and inasmuch as the primary current is stronger and weaker in turn, an alternating current is established circuit, will be similarly affected. The greater the change in the primary current, whether increase or decrease, the stronger is the current induced in the secondary circuit, and the louder the sound heard in the receiver.

CONSTRUCTION AND ACTION OF COMPONENT PARTS.

1. *The Battery.*

In the regulation Service telephone the battery consists of two "dry" cells, of external dimensions $3\frac{3}{4} \times 1\frac{1}{2} \times 1\frac{1}{2}$ in., connected in series. The negative plate takes the form of a zinc box, which serves as a container for the other ingredients. Lining the zinc box is a paste containing sal ammoniac, which acts as the exciting material. The positive plate consists of a carbon rod located in the centre of the cell, the intervening space being filled with a mixture of black oxide of manganese, carbon, and sal ammoniac, the first-named acting as depolariser. These cells are issued in the dry state, and must be moistened before use. For this purpose an open glass tube is provided in the top of the cell, into which water is poured according to instructions printed on the side of each cell. After adding the water, eight to ten hours are required before each part has become moist, when the cell is ready for use. When

Operation. Two cells in series used.	Current (amperes).	Useful life of cell.	Final voltage.
Using simple buzzer	0·2—0·3	15 hours	1·2 or less
Using polarised buzzer	0·1—0·15	25 30 ,,	,,
Speaking through microphone . . .	0·2—0·4	12 ,,	,,

fresh these cells have an E.M.F. of 1·5 volts, and in this condition give satisfactory results. Continuous working, however, soon causes deterioration, and when the voltage has fallen to 1·2 per cell it is difficult to transmit messages either by buzzer or speech. Some cells last longer than others, but in the average case the particulars given on page 882 have been found to hold true.

The foregoing figures indicate that frequent renewal of cells is necessary when the telephones are in active use. The best clue to the condition of a cell is furnished by the readings

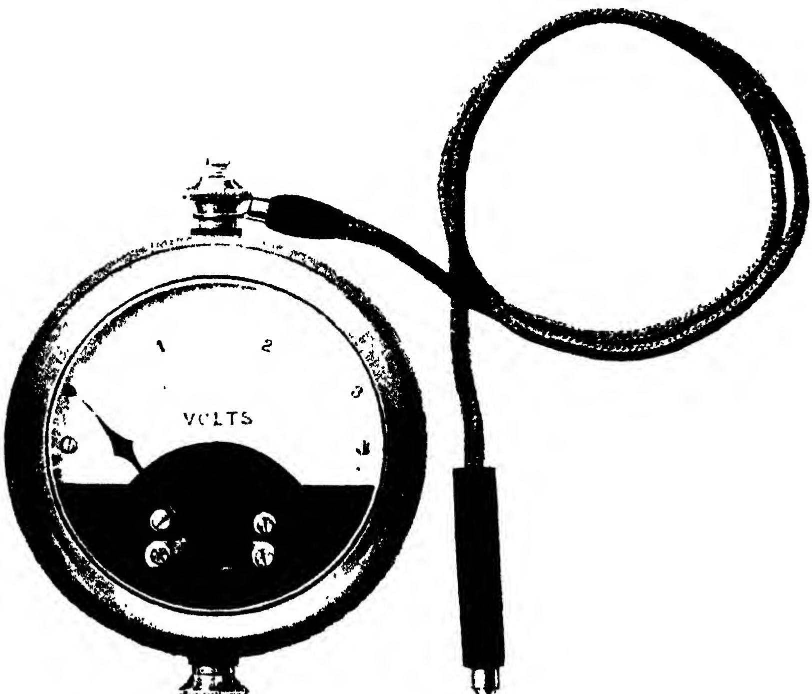

Fig. 2.—Pocket Voltmeter for Use with Field Telephones.

of a voltmeter placed across its terminals, and any cell showing a less figure than 1·3 should be replaced by a new one. Voltmeters used for this purpose should be of the moving-coil pattern, and capable of reading accurately to $\frac{1}{10}$ volt. A satisfactory form, of size suitable for the pocket, is shown in Fig. 2. It is a moving-coil instrument, having a range of 0–3 volts, divided into tenths, and is made by the Stonebridge Electrical Company, Willesden. Failing a voltmeter, the telephonist may deduce the failure of the cells from the weakness of the note of his buzzer.

2.—*The Induction Coil.*

The induction coil used in field telephones is usually 2 to 3 in. long, and possesses a core composed of a bundle of iron wires. Its function is to convert low-pressure currents in the primary circuit into high-pressure currents in the secondary, which travel through the line and receivers. The resistance of the primary winding is about 0·5 ohm when used with a simple buzzer, and about 3 ohms when in conjunction with a polarised buzzer, such as in the "D Mark III." The secondary winding possesses about thirty times as many turns as the primary. The direct currents passing through the primary, which continually fluctuate in strength, produce alternating currents in the secondary and its connections.

3.—*The Buzzer or Vibrator.*

This part of the instrument serves the double purpose of acting as a call-up, and also as a means of transmitting messages by Morse code. In the simple form, the action is identical with that of an ordinary electric bell. Referring to Fig. 1, the buzzer V is seen to consist of two windings, through which the current from the

battery divides. These windings are provided with iron cores (not shown in the drawing), and the path of the current is continued through the iron armature, D, and the adjusting-screw, A. When a current passes through the windings, the cores are magnetised, and attract the free end of D, thereby drawing it away from A and breaking the circuit. The cores then lose their magnetism, and the armature springs back and renews contact with A, thus restoring the circuit. The rapid to-and-fro movement of D gives rise to a buzzing sound, from whence the arrangement derives its name. As the buzzer is in circuit with the primary of the induction coil, every make and break of the current caused by the vibration of D will give rise to an induced current in the secondary, which, passing through the line circuit, acts on the receivers so as to reproduce the note emitted by D. The key, V.K, is used as a Morse key for the purpose of sending messages, a long contact representing a "dash," and short contact a "dot."

The objection to the simple buzzer described, which is used in the Service "D Mark II" field telephone—now becoming obsolete—is that the note lacks sharpness, and is not suited to the rapid transmission of messages. In the Stevens field telephone the core of the induction coil, which becomes magnetised when a current passes through the primary, is used to attract the armature, a plan which simplifies construction by dispensing with the separate buzzer coils. A polarised buzzer, such as will be described later in connection with the "D Mark III" telephone, is preferable to a simple buzzer, as it requires less current to work and gives a sharper note.

4.—*The Receiver.*

For economy of weight and space, the receivers of field telephones are made in the "watch" form. The iron pole-pieces are mounted on a circular magnet, and are wound with coils of combined resistance about 200 ohms. The iron diaphragm, which is set into vibration by the alternating currents circulating round the coils, is held in position by the screw-top of the case, and is prevented from touching the pole-pieces by means of a brass washer round its rim. For convenience of re-wiring, the terminals are, or should be, placed on the exterior of the case.

5.—*The Microphone or Transmitter.*

This part consists of a replaceable capsule contained in a metal case, the top of which screws on to the lower portion, and holds the capsule in position. The capsule contains a carbon block, with cavities in its upper surface which are filled with small spherical granules of carbon. Touching the granules is a carbon disc, protected from moisture by a covering of mica. When in use the current from the battery passes through the granules, and when the carbon disc is vibrating, the area of contact at this part of the circuit is constantly changing. This results in changes in the strength of the current, and, as the primary of the induction coil is in the circuit, induced currents are produced in the secondary and its connections, which cause the diaphragm of the receiver to vibrate in unison with the disc of the capsule.

6.—*The Condenser.*

Although not essential to the transmission of sounds, a condenser, inserted in the line circuit, is a useful adjunct to a field telephone. It is made up of alternate sheets of tin-foil and paraffined paper, and possesses a capacity of $\frac{1}{30}$ to $\frac{1}{40}$ microfarad. A condenser, whilst stopping the passage of direct currents, permits alternating currents to pass through, although somewhat impaired in strength. Owing to this property, a pair of field telephones, with their condensers in circuit, may be attached to an existing telegraph line, and messages sent without interference. The direct currents used in telegraphy cannot pass through the telephones owing to the condenser; and the alternating currents due to the telephones do not affect the telegraph instruments; and hence both operations may proceed simultaneously. This fact is frequently taken advantage of in the field. It is also customary to use a condenser in the circuit when tapping a telephone line, as less current is then diverted through the instrument used for tapping, and the communication from end to end not unduly interfered with. In the D Mark II telephone a condenser is permanently in the circuit; in more modern forms, such as the D Mark III, Stevens' and Siemens' instruments, the use of the condenser is optional, and is only resorted to for the special purposes mentioned above.

7.—*Earth Contacts.*

The use of an earth return for field telephone has the advantage of saving a second line, with the attendant trouble of laying out. Contact with the ground is secured by means of a pointed iron pin, about 14 in. long and $\frac{3}{4}$ in. in diameter, which is driven in to a

depth of several inches. This pin carries a terminal, and is connected to the telephone by a short wire. In damp ground a pocket-knife, or even a wire inserted into the ground, gives sufficient contact. In dry, sandy ground it is difficult to secure a good "earth," and it is necessary to pour water round the pin. Should this fail, a return wire must be used.

In the D Mark III and Siemens' telephones a metal base, permanently connected to the earth terminal, is provided, so that when placed on the ground an earth-pin is unnecessary. The International Electric Co. provide a special heel-plate, to which a wire from the telephone may be attached, so that a telephonist may use his instrument whilst walking.

the side; and a soft portion of the leather lid enables the buzzer to be worked without opening the case. A shoulder-strap is provided, and the total weight is about 5½ lb. The circuit is identical with Fig. 1, with the addition of a condenser between the armature D and the screw A.

The chief defects of the instrument are the unsuitable character of the buzzer for Morse signalling; the high current required to work the buzzer, which soon exhausts the cells; and the liability of the connecting cords of the microphone and receiver to breakage. It requires constant supervision to keep in order, and its complete withdrawal in favour of the D Mark III will be an unmixed advantage.

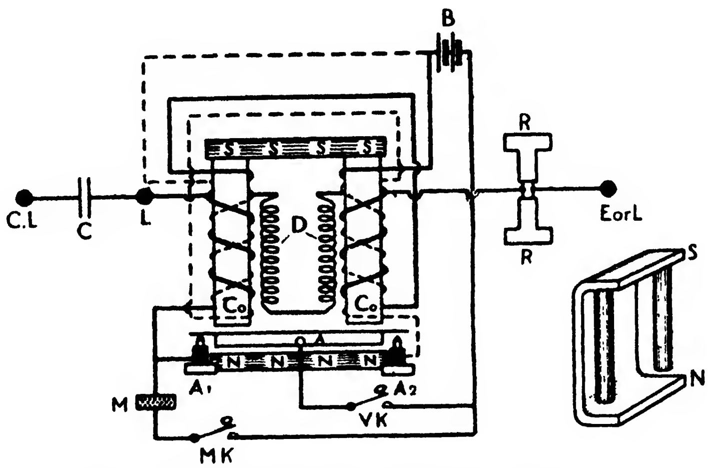

FIG. 3.—CIRCUIT OF D MARK III FIELD TELEPHONE.

DESCRIPTION OF FIELD TELEPHONES.

1.—*The Service D Mark II.*

This pattern was much used at the commencement of the war. It superseded an older and smaller form known as the Mark I, but is in turn being rapidly replaced by the Mark III. It possesses a simple buzzer, mounted with the induction coil on a fibre block. Beneath this are placed two dry cells, and a metal box containing two condensers, one of which is connected permanently to the line circuit, and the other placed across the buzzer terminals to diminish sparking at the contact with the armature. The microphone and receiver are connected by flexible copper wires to terminals on the top of the fibre block; and the whole is contained in a leather case provided with pockets for holding the microphone and receiver when not in use. The line and earth terminals protrude from

2.—*The Service D Mark III Telephone.*

The special features of this instrument, which is the latest Service pattern, are the use of a polarised buzzer; and the arrangement by which the windings round the cores of the buzzer are made to constitute the induction coil. The circuit is shown in Fig. 3, and at first sight appears complicated. The action of the buzzer resembles that of the polarised bell used in ordinary telephones, but whereas this bell is actuated by an alternating current, a direct current only is available for the buzzer. The same result is secured, however, by causing the battery current to pass alternately through each of two windings round the cores, which, being oppositely disposed, produce opposite magnetic effects. The iron cores, Co, are mounted on the south pole, S, of a permanent magnet bent twice at right angles, as shown at the side of Fig. 3. The lower extremities

of the cores will therefore possess S polarity. An iron armature pivoted at its centre is placed between the ends of the cores and the N pole of the permanent magnet. The upper face of this armature has N polarity, and carries at either extremity a thin strip of steel. In the position of rest, one of these strips touches an adjusting-screw A_1, the other being free of the screw A_2. Each core possesses two windings, one right-handed and the other left. On pressing the buzzer key, V.K, the current flows through the armature to the screw A_1, and thence round the cores by the path indicated by the full line. This results in the S pole of the core opposite A_1 becoming strengthened, whilst that of the core opposite A_2 is weakened; and hence the armature is drawn away from A_1 and makes contact at the other end with A_2. The circuit completed by this contact is shown by the dotted line, and the effect now is to strengthen the S pole opposite A_2 and to weaken the other. Hence the armature leaves A_2 and again makes contact with A_1, and thus is set into rapid vibration. When the screws are properly adjusted, so as to make the throw of the armature even on both sides, a keen, sharply-defined note is obtained, suited in every respect to calling-up or rapid Morse signalling. This buzzer requires a minimum current of 0·1 ampere for satisfactory working, this being only about one-half that needed for a single buzzer. A better result is thus secured with less current and consequent extension of the life of the battery.

The secondary of the induction coil, D, shown in the drawing at the sides of the cores, is wound over the buzzer coils, and every make or break of contact between the armature and the screws results in the production of an induced current in the secondary circuit, which, passing through the line and receivers at both ends, produces a response to the note of the buzzer.

The microphone, M, is connected so that when its key, M.K, is pressed the current passes through the full line winding of the buzzer cores, which then serves as the primary of the induction coil, the fluctuations in current caused by speaking into the microphone resulting in induced currents through the secondary circuit as in the case of the buzzer.

Two receivers, R, are used, joined to the same terminals. The terminal marked L or E is connected to a metal plate at the base of the instrument, which serves as earth contact. The condenser, C, is placed between the terminals L and C.L, and is only in the circuit when the line is connected to the latter.

The appearance of the instrument is shown in Fig. 4. It consists of two compartments, provided with lids, the taller containing the cells and the lower the buzzer and condenser. On the lower lid are mounted the buzzer key, terminals for the two receivers and microphone, marked R and M respectively; and also three terminals lettered L, C.L, and L or E, for connection to line and earth. The buzzer itself is fastened on the under side of the lid, and the condenser is at the bottom of the compartment.

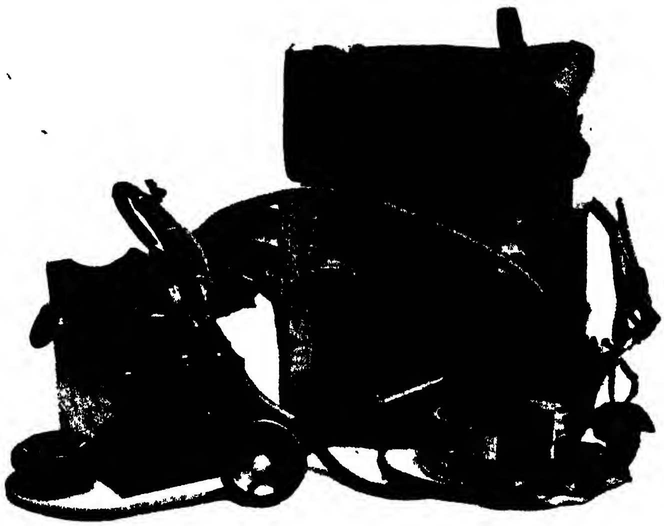

FIG. 4.—D MARK III TELEPH

One of the two receivers is contained in a leather case provided with a head-strap, so that it may be fastened to the ear when awaiting a call, leaving both hands free. The other receiver forms the upper part of a hand combination, which may be telescoped into a small size for packing; the lower part being the microphone, the key of which is in the handle. For transit, all the parts are placed in a leather case, 8½ in. × 4 in. in plan, and 6½ in. high, to which a shoulder-strap is attached. The total weight is a little over 8 lb.

The use of two receivers is a distinct advantage. If the cords of one should break the other may still be used, and the line circuit remains intact. A very important message may be heard simultaneously by two men, the risk of misinterpretation being thereby greatly reduced. Further, one of the receivers may be detached and re-wired if necessary, without putting the telephone out of action. The clear note of the buzzer is of great value, as Morse code messages are frequently the only means of communication in the firing line, talking being inaudible. The only weak point is the tendency of the connecting cords to break, and this might be overcome by the use of stranded steel wire instead of copper. With this improvement, and renewal of the cells when the voltage of each falls below 1·3, this telephone would remain in order under all normal conditions.

3.—*Siemens' Field Telephone.*

This instrument, shown in Fig. 5, resembles the D Mark III in the respect that a polarised

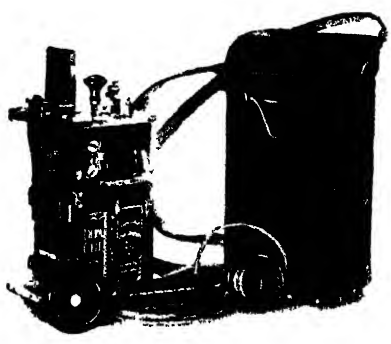

FIG. 5.—SIEMENS' FIELD TELEPHONE.

buzzer is used. A separate induction coil is employed, however; and a single receiver is provided, forming part of a hand combination. Two dry cells are used; and the various parts and terminals are fastened to a wooden frame, which, together with the hand combination, fits into a leather case provided with a sling. This case has a metal base, connected to the earth terminal, so that when placed on the ground and coupled to line, the telephone is ready for work. For all practical purposes it may be regarded as equivalent to the Mark III, except for the absence of the second receiver and head-strap.

4.—*Stevens' Field Telephone.*

Amongst the telephones used to augment the Service pattern, the form devised by Stevens (Patent 23172, 1911)* has been much used. It is illustrated in Fig. 6 (p. 888), and possesses several distinctive features. A simple buzzer, operated by the primary of the induction coil, is used, and a second adjusting screw, external to the circuit, is provided for the purpose of regulating the throw of the armature and producing a keener note. Four dry cells are provided, only two of which are normally used; but when the note of the buzzer weakens, the other two may be brought into the circuit by turning a knob. The use of the condenser is optional, three terminals, lettered as in the D Mark III being provided. The receiver and microphone are separate, each being of watch form, and strongly constructed. The outfit is packed in a leather case with sling, the total weight being 6¼ lb.

The note emitted by the buzzer is loud and has a high pitch, so that it could be heard above the noise of gunfire, but is not so sharp as that produced by a polarised buzzer. The reserve of cells is a distinct advantage, as in many situations it is difficult to procure a new supply.

Upkeep of Field Telephones.

In order to keep a telephone in working order, the operator must thoroughly understand his instrument, and be able to test each part and perform the necessary adjustments. In order to discover the condition of the various parts, the following tests are conducted in the order given:—

Test 1.—Press the buzzer key, adjusting the screws if necessary. A loud buzz should be obtained; if weak, it denotes that the cells have run down and should be renewed; this may be confirmed by a pocket voltmeter. If no buzz can be produced, a connection is probably loose, and the circuit must be examined; or possibly the cells are badly run down or short-circuited.

* Made by the International Electric Company, Ltd. Kilburn, N.W.

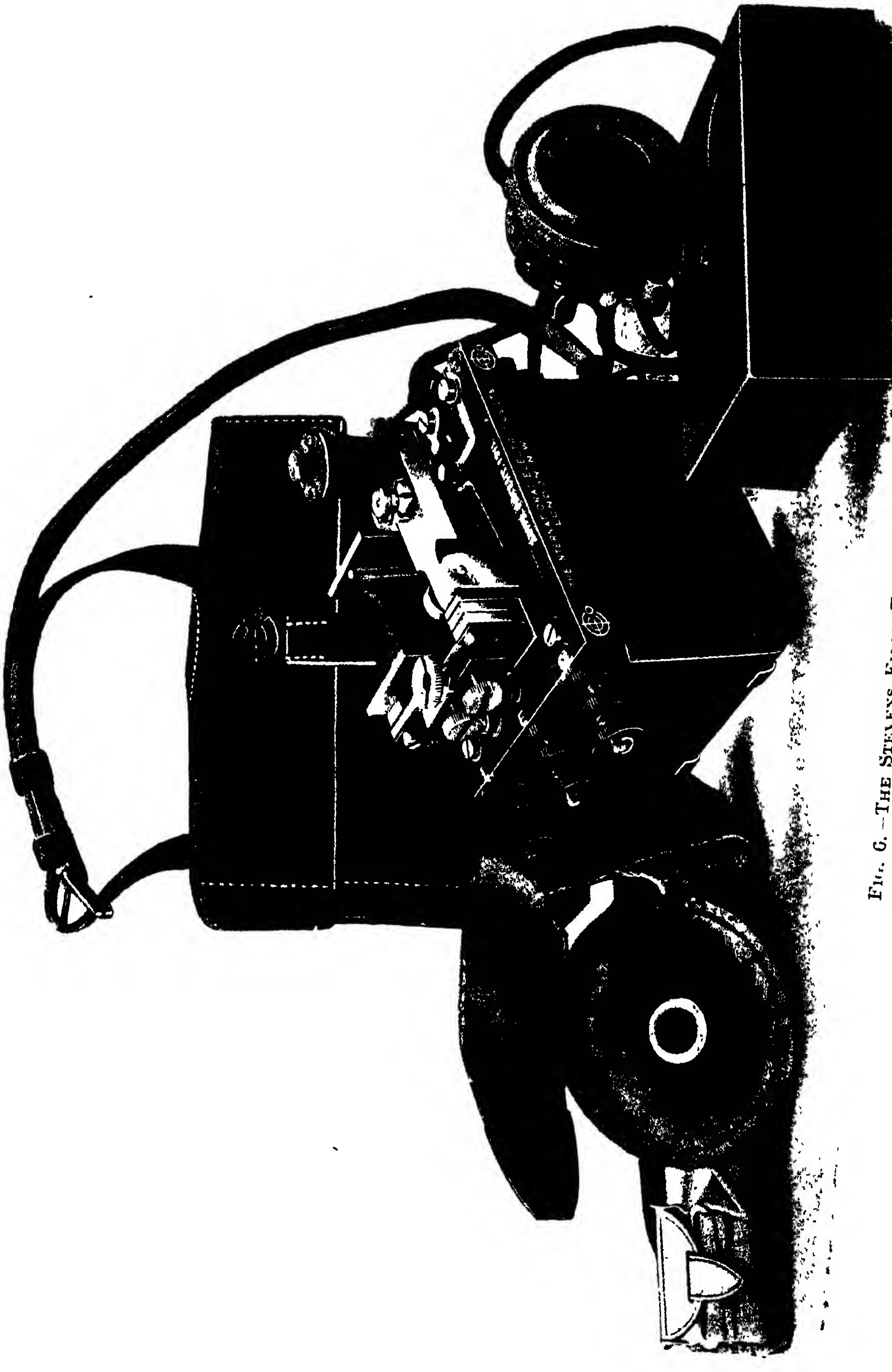

FIG. 6.—THE STEVENS FIELD TELEPHONE.

Test 2.—Connect the line and earth terminals by a short piece of wire, and press the buzzer key. It should sound loudly in the receiver. If not, the receiver cords are broken or loose, or the receiver is short-circuited. More unlikely causes are the diaphragm touching the poles of the magnet, or a break in the windings of the coil. The defect, whatever it may be caused by, must be remedied at once.

Test 3.—Without removing the wire connecting L and E, press down the microphone key. A click should be heard in the receiver, both on contact and release of the key. On blowing into the microphone, the sound should be heard in the receiver. If no sound is heard, either the cords are loose or broken, or the microphone is short-circuited, or the capsule is damaged and requires renewal.

Any telephone responding successfully to these three tests may be regarded as in good condition; and if afterwards a message cannot be transmitted, the fault lies in the line or in the telephone at the other end. Unless the telephone be in working order, as indicated by the tests, any attempt to use it would be futile.

The Laying and Upkeep of Lines.

The lines for field telephones are made of steel wire, which possesses greater mechanical strength than copper wire, and is therefore not so easily broken. A thin, single-stranded steel wire, with an insulation of varnish, is much used when a temporary communication has to be established, or when a body of men moving forward have to keep in touch with the rear. Such a wire has the advantage of lightness, and a considerable length may be contained on a small reel. For work of a more permanent character, wires composed of several steel strands, and insulated with rubber and woven fabric, are used, and are less liable to short circuits to earth than the former. Reels of different sizes, according to the length of wire contained, are employed; the smaller reels are carried on a body-belt by the linesman, whilst the larger are mounted on special barrows. The lines are laid on the surface, or placed a few inches underground, according to circumstances, and in the latter case perfect insulation is absolutely necessary. In laying a surface wire between two stations, the safest route, even if circuitous, is taken. Open spaces are avoided, the wire being laid along a hedgerow in preference to crossing a field. If a road has to be crossed, two trees or other suitable objects are chosen, the line being tied to the base of the first tree and drawn tightly up the trunk, and then passed over a suitable fork at a minimum height of 15 ft. It is then passed over a fork on the opposite tree, drawn tight across the road and down the trunk, and secured at the base. In the absence of trees or poles the line must be buried in the road. A line should, if possible, be kept at least ten yards away from any other line, otherwise induction effects will give rise to overhearing in both, and cause confusion.

The breaking of telephone lines by fragments of bursting shells is a very common occurrence, and as the cutting-off of communications may have very serious results, measures are taken to maintain a complete circuit as long as possible. To this end multiple lines are used, and one arrangement, known as the "ladder" system, is indicated in Fig. 7. The wire is formed into

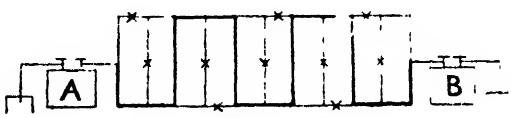

FIG. 7.—THE "LADDER" SYSTEM OF TELEPHONE LINES.

a network resembling a ladder, with a connection at either end to the telephones A and B. Although numerous breaks may occur, as indicated by the crosses, a continuous circuit from A to B, marked out by the thick line, still exists. Networks of this kind are sometimes buried in the ground, and enable communication to be kept up for long periods. The method has two drawbacks; first, a large number of joints have to be made during laying; and, second, each break is liable to cause a short circuit to earth, difficult to locate, which would prevent messages passing between the two ends.

An alternative method is shown in Fig. 8, where four lines are laid between the telephones A and B, which at one spot are brought to junctions D in a dug-out, where a linesman is placed provided with a telephone. C. It must be understood that the lines, shown parallel in the drawing, may take widely different routes between the ends and the dug-out. As indicated by the crosses, all the lines are broken; 1 and 4 on the right, and 2 and 3 on the left of D. By joining each line in turn to the telephone C, these breaks and their bearings may be discovered; thus, by connecting to 4 it will be found possible to communicate with A, but

not with B, and hence a break on this line between D and B is inferred. Similarly it would be found that 2 is whole between D and B, but broken on the other side. By joining the whole portions of the lines 4 and 2, or 1 and 3, at the junction-box D, a continuous line between A and B is again established. Knowing the direction of the breaks, the linesman takes a favourable opportunity of repairing them, the repair being executed by laying bare the wires at the broken ends and tying them together by a reef knot, the bare part being then insulated with rubber tape or tubing. This method has the advantage that a break may be located, and that a broken line which causes a short circuit to earth may be disconnected until the broken part has been repaired.

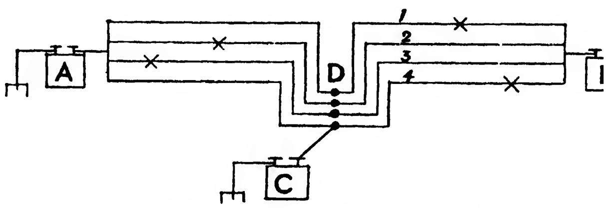

FIG. 8.—MULTIPLE LINE SYSTEM.

FIELD EXCHANGES.

When several telephones require to be kept in touch, an exchange is used. A battery commander may thus communicate with his observer, ammunition waggons, and guns, or any of these units with each other. A small portable exchange, provided with plugs or switches, is used in this and similar cases.

DUTIES OF A FIELD TELEPHONIST.

The office of field telephonist is one of great responsibility. He must be capable of keeping his instruments in order, and of executing ordinary repairs such as re-wiring the parts. He must also be capable of laying lines, detecting and locating breakages, and repairing them satisfactorily. He must also be able to transmit and receive messages by Morse code at a minimum rate of twelve words per minute. He is often compelled to act in an emergency, frequently at risk of his life, in order to restore or keep up communication. His everyday duties demand knowledge, skill, and courage, and are important in the highest degree.

CONCLUSION.

The subject of field telephones is a wide one, and it has only been possible in this lecture to touch on its main features. It will have been gathered, however, that the training of a field telephonist cannot be accomplished by drill alone. He must, if he is to be thoroughly reliable, possess a knowledge of the working parts of his instrument, so as rapidly to detect and rectify a fault. And this leads me to suggest that science teachers throughout the country might with advantage be used to impart this necessary knowledge in all localities where special instruction is not available. Such instruction should be carried out on an approved plan, and would require co-operation with the military authorities, in order that the actual instruments might be available for demonstration. By this means an abundance of reliable men could be secured in a short time, and with little expense. There has been much nebulous talk about the "mobilisation of science," but to obtain efficient results it is necessary to provide each man with work suited to his experience and qualifications. This condition would be fulfilled by utilising capable teachers for the training of field telephonists, and the results would, in my opinion, be of great value to the country at the present juncture. A properly organised scheme would not be difficult to produce, would cost little in operation, and would enable the country to take advantage of the special qualifications of teachers of science.

STANDARDISATION OF BOMB CALORIMETERS.

There has recently been issued by the United States Bureau of Standards a paper describing briefly the methods of calibrating and using bomb calorimeters, such as are used in determining the amount of heat available from a given weight of coal or coke or other combustible. The amount of heat which can be obtained depends largely upon the kind and quality of fuel. When purchased in large quantities, therefore, a fuel is commonly tested to determine the amount of heat available per pound, and the price paid depends upon the results of these tests.

The instrument used for such tests is called the bomb calorimeter, and consists essentially of a steel shell or "bomb" in which a small weighed

sample of the fuel can be burned in pure oxygen gas. The bomb is immersed in a known amount of water before the sample is ignited, the heat produced warms the water, and by suitable measurements of the change of temperature the amount of heat can be calculated.

Provision is made by the Bureau of Standards for standardising bomb calorimeters by means of standard samples of certain pure materials, viz., sugar, naphthalene, and benzoic acid. By burning known amounts of these substances in the bomb the observer determines the amount of heat required to raise the temperature of the bomb and water 1°. This being determined, the amount of heat furnished by a given sample of coal burned in the same bomb with the same amount of water can be found.

Thus these standard samples, which are sent all over the United States, serve as standards of heat and make it possible to get the same results from tests made anywhere, much as the use of the standards of length and of mass makes a yard or a pound the same everywhere.

MANJACK DEPOSITS IN THE BRITISH WEST INDIES.

Trinidad.

There are in the island of Trinidad large deposits of manjack, especially in the San Fernando section, where are situated the Vistabella and the Marabella properties. During the past decade approximately 18,000 tons were exported in a crude state.

In outward form and general appearance manjack is not unlike fine coal, and is essentially a bituminous substance. It is an oil residuum occurring in lenticular seams between walls of peculiar clay, which appear to have absorbed the oil under very heavy pressure. It is jet black in colour and resinous in its nature, and has long been known for its insulating properties in the manufacture of electric coils, dynamos, and generators.

From a recent report by the United States Consul in Trinidad, it appears that the Vistabella manjack properties are worked under a long lease by an American company, which, besides exploiting and exporting manjack in its natural state, has undertaken the manufacture of certain well-defined compounds. One of these is a high-grade black manjack paint for use on smokestacks and on boilers, both inside and out; another is a preparation suitable for greasing pipe threads, dressing wire rope, etc.

Barbados.

Barbados manjack is of two varieties—the conchoidal and the columnar. The first is the more valuable, and a newly-fractured specimen cannot be distinguished from jet, so far as outward appearance is concerned. At the present time the exportations are mainly to the United States, where Barbados manjack is used in the manufacture of high-grade insulating black varnish.

AGRICULTURE IN THE FEDERATED MALAY STATES.

It appears from the Selangor Administration Report for 1914 that the approximate areas under different kinds of cultivation in that State last year were as follows:—

	Acres
Rubber	245,503
Coconuts	35,092
Coffee	9,953
Padi	9,448
Various	22,000

Rubber shows a substantial increase over the previous year's figures, but there is a decrease under the head of coconuts. The latter is inexplicable, as the cultivation of coconuts is steadily extending. The area under padi has increased by nearly 3,000 acres, and the development of this form of cultivation is most satisfactory.

As regards Negri Sembilang, the State Administration Report for 1914 gives the following figures as showing approximately the areas devoted to the principal products cultivated in that State last year:—

	Acres
Rubber	117,000
Padi	28,000
Coconuts	20,000
Gambier	4,500
Tapioca	1,300
Fruit trees	12,000

About 3,300 acres are under various other products.

CORRESPONDENCE.

DESTRUCTION OF WASPS.

I have recently discovered (and I do not know if the fact is generally known) that the vapour of benzol and petrol is quickly fatal to wasps and many other insects. Touched with a brush dipped in either spirit they instantly collapse and die.

During the past few days I have destroyed three wasps' nests by the injection of about 2 oz. of benzol into the nest by means of a small syringe. The first injection is sprayed over the mouth of the nest. This entirely prevents the escape of any of the insects, and kills the sentry wasps at once The balance is sprayed right into the hole.

One partly destroyed nest was laid open, and several hundred wasps were found, covering an area as large as a cheese plate. The first discharge of the syringe over these killed the lot, and not one escaped. The gas is not ignited in any way, but acts probably either by asphyxiation or by producing a fatal anæsthetic effect.

The method is so simple and easy of manipulation, that I feel it cannot be too widely known, and as it involves the use of no dangerous or poisonous substance, is highly to be recommended where these pests abound.

A. H. Mitchell.

Horn's Green,
Knockholt, Kent.

GENERAL NOTES.

NUMBER OF THRASHING MACHINES IN ITALY.—According to a census lately made by order of the Minister of Agriculture in Italy, it seems that the total number of thrashing machines in that country does not exceed 11,000. Of this number 2,800 are to be found in the region of Emilia. The shortage of labour in the rural districts in consequence of the present war conditions is causing considerable uneasiness amongst the landowners and farmers generally. The Government are taking steps to utilise all existing harvesting and thrashing machinery to the best advantage during the coming harvest. Last spring forty haymaking machines were placed at the disposal of the agricultural societies by the Italian Government, in order to facilitate the rapid storage of forage.

WHEAT IN EGYPT.—According to a note in the *Bulletin* of the Imperial Institute, wheat in Egypt in an ordinary year occupies about 17 per cent. of the total cultivated area, only maize (24 per cent.) and cotton (23·3 per cent.) occupying a larger total. In spite of this the export of wheat is small, and more than counterbalanced by the amount imported. Thus in 1913 about 2,400 tons were exported, mainly to Turkey, and 4,600 tons were imported, chiefly from India. In addition to this, large quantities of wheat-flour were imported. In September, 1914, on account of the anticipated reduction in the demand for cotton in the world's market, a decree was promulgated in Egypt that not more than 1,000,000 acres, or three-quarters of the area put down to the crop in 1914 were to be planted with cotton. The land thus set free was to be devoted to cereals, in the hope of rendering the country more independent of outside supplies, and of probably producing a surplus for export. Wheat is, of course, a winter crop in Egypt, and is grown in about equal amounts in Upper and Lower Egypt.

CONDITION OF RUSSIAN LINEN INDUSTRY.—Since the beginning of last autumn the Russian concerns engaged in the manufacture of linen have been extremely busy meeting the large demand for coarse flax fabrics, tarpaulin, sacks, etc. The spinning mills have also increased their production in consequence of the extensive demand on the part of the weavers and other buyers of flax thread. The prices of both flax yarn and manufactured goods have increased. Last year one hundred bags were valued at £3 to £3 4*s.*, according to their weight, while now prices have reached £4 1*s.* 6*d.* to £4 6*s.* Average grades of yarn have risen in price from £1 2*s.* 6*d.* to £2 7*s.* 10*d.* for No. 14, and from £1 14*s.* to £2 3*s.* for No. 30. At the same time the manufacturing concerns have been deprived of a great number of experienced workmen, and are now suffering from the lack of hands. Many weaving mills have introduced a system of working in two shifts of nine hours each. In some kinds of work the men have been replaced by women and minors with considerable success. There is, however, a great lack of combers, as this kind of work has proved beyond the physical power of women. The price of labour has increased, daily wages having risen by 2½*d.* to 5*d.*, and monthly pay by 6*s.* 5*d.* to 10*s.* 9*d.* From a recent report by the United States Consul-General at Moscow, it appears that a considerable proportion of the weaving is done in the cottages of the peasants having their own looms, and receiving the yarn from the contractors. One weaver can turn out two, three, and four pieces of linen per week. The price of labour per piece is now 2*s.* 11*d.* to 3*s.*, against 1*s.* 6*d.* to 1*s.* 8½*d.* paid previously. According to official data, there are twelve flax spinning mills in the Province of Vladimir (the principal district of the flax industry), while there are 110 weaving mills with 21,659 workmen. In 1908 there were ten spinning mills and only twenty weaving mills.

COAL DEPOSITS IN SWEDEN.—Dr. Edward Erdmann, State Geologist of Sweden, has made investigations regarding the coal area in the Province of Scania, and according to his report, quoted by the United States Consul at Goteborg, the coal deposits there are calculated to amount to 106,500,000 tons. The rate of mining during the last few years has been only about 300,000 tons per annum. The annual consumption of coal in Sweden amounts to about 4,500,000 tons, and the domestic production supplies only about 7 per cent. of this, while the balance, or 93 per cent., must be imported from abroad.

JAPAN'S PAPER TRADE.—In a report to the U.S. Department of Commerce by Consul-General George H. Scidmore, Yokohama, Japan, it is stated that since the war interfered with the European paper trade inquiries have come to Japan from all over the East for paper, especially for news-print paper. The first export orders were from Hong-Kong, followed by Tientsin, Shanghai, and the Yangtze ports. More recently orders have been received from Bombay, Calcutta, and Manila. About 1,000,000 lb. is the present monthly export, and according to the *Mainichi* (Osaka), Siberia and Australia are the only markets in these longitudes not taking Japanese paper. Tientsin is the largest consumer, taking about half the China imports. Inquiries are being received from China for qualities of paper other than news-print paper, but the news trade is believed to be the most promising one, and as the foreign demand increases more rapidly than the Japanese, the *Japan Chronicle* believes that Japan will be quite capable of capturing the whole of the Oriental trade, and even of holding on to it in the face of the restoration of competition which will be seen when the war ends. Although Japanese news-print is confessedly poor stuff, it is hoped to hold the market by the low price.

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All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICE.

INDIAN SECTION COMMITTEE.

The following is the list of the Indian Section Committee, as appointed by the Council: -

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PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

FOODSTUFFS.

By David Sommerville, B.A., M.Sc., M.D.,
Assistant Professor of Hygiene and Public Health, King's College, London.

Lecture I.—Delivered April 26th, 1915.

When it is considered that the growth, development and power to function of all the tissues of the body are derived directly from the foods taken into the alimentary canal, there need be no apology for investing these substances with an importance of the first order.

This discussion will be concerned only with certain aspects of the subject which at the moment appear to be of special interest.

Upon many workers in the field of practical medicine the conviction has of late been forced that largely, if not wholly, in proportion as we understand aright what happens to foods as they enter the body, are incorporated with the cells of the organism, and as so much waste material finally leave it, so can we hope to be able to assist the body in disease, and that in this matter all other considerations are of but minor importance.

It has been customary to classify foodstuffs in four categories: (1) Proteins; (2) Carbohydrates; (3) Fats; and (4) Inorganic Substances. Of these the proteins are by far the most complex.

In the forties of last century Mulder wrote of "protein" as a single body, "forming different compounds with phosphorus and sulphur, and presenting accordingly differences in appearance and physical properties." This author tells us that "it has received the name 'protein' because it is the origin of so many dissimilar bodies and is itself a primary substance." Liebig's notions of protein were somewhat similar. We now know that there are some forty to fifty proteins occurring in animals and

plants, and that chemically their structure is the same in the two kingdoms. In 1728 Beccari informed the Academy of Bologna that in wheat flour he had found two types of substance - "those things which are extracted from vegetables, and another which it appeared impossible to extract except from animal matter." After this discovery the presence of coagulable protein was soon recognised in the juices of different plants: and the similarity of this substance to egg albumin caused it to be known for a long time as albumin.

Various methods have been employed for determining the composition of the protein molecule. Of these hydrolysis by acids, hydrolysis by alkalies, and hydrolysis by proteoclastic enzymes have proved the most fruitful.

The sharp line of demarcation which formerly was drawn between proteins on the one hand as nitrogen-containing bodies, and carbohydrates and fats on the other as non-nitrogenous bodies, was modified considerably when it became known that the protein molecule contains one or more carbohydrate groups. The study of the production of sugar from protein in diabetes has enlarged our conceptions of the nature of the protein molecule. The work of Schutzenberger, Horbaczewski, Schulze, and others on the products of hydrolysis of proteins, resulted in the separation of a number of amino-acids. Investigations on the chemical constitution of these had been going on for several decades when Emil Fischer, about the beginning of the present century, took up the work, and by the introduction of his new ester method of separating mono-amino-acids from protein digests, threw a flood of light on the characters of a number of these bodies. It is now fairly clear that the protein molecule is mainly constructed of a series of amino-acids. The following have been separated: –

$CH_2 . NH_2 . COOH$, amino-acetic acid or glycine.

$CH_3 . CH(NH_2) . COOH$, a-amino-propionic acid or alanine.

$CH_3 . CH_2 . CH(NH_2) . COOH$, a-amino-butyric acid in casein.

$(CH_3)_2CH . CH(NH_2) . COOH$, a-amino-isovalerianic acid or valine.

$(CH_3)_2CH . CH_2 . CH(NH_2) . COOH$, a-amino-isocaproic acid or leucine.

An isomeride of leucine, a-amino-n-hexoic acid (separated by Abderhalden and Weil from nervous tissue).

Isoleucine, $\frac{CH_3}{C_2H_5}CH . CH(NH_2) . COOH$.

$C_6H_5 . CH_2 . CH(NH_2) . COOH$, β-phenyl-a-amino-propionic acid or phenyl alanine.


$CH_2 . CH(NH_2) . COOH$, β-parahydroxy phenyl-a-amino-propionic acid or tyrosine.

OH

$CH_2OH . CH(NH_2) . COOH$, β-hydroxy a-amino-propionic acid or serine.

$S . CH_2 . CH(NH_2) . COOH$

|

$S . CH_2 . CH(NH_2) . COOH$, dicysteine or cystine.

$CH_2 . COOH$

|

$CH(NH_2) . COOH$, a-amino-succinic acid or a-aspartic acid.

[$CH_2 . COOH$

|

$CH(NH_2)_2 . CONH_2$, the amide of a-aspartic acid, has been shown by Schulze to play an important part in the germination of seeds.]

$CH_2 . CH_2 . COOH$

|

$CH(NH_2) . COOH$, a-amino-glutaric acid or glutamic acid.

$\diagup NH_2$

$C = NH$

$\diagdown NH . CH_2 . CH_2 . CH_2 . CH(NH_2) . COOH$, δ-guanidine-a-amino-valerianic acid or arginine; this body, as also creatine, contains the guanidine or imido-urea group

NH_2

$C = NH$.

NH_2.

$CH_2(NH_2) . CH_2 . CH_2 . CH_2 . CH(NH_2) . COOH$, diamino-caproic acid or lysine. Another diamino compound separated from casein by Fischer and Abderhalden (constitution not at the time determined) was named diaminotrihydroxydodecoic acid.

CH — NH

$\diagdown$ CH, a-amino-β-imidazol-propionic

C ——— N

|

$CH_2 . CH(NH_2) . COOH$

acid or histidine, a heterocyclic body separated by Kossel and studied by Pauly.

CH_2 — CH_2

| |

CH_2 CH . COOH, a-pyrrolidine-carboxylic acid or proline,

NH

and CH_2 —— CH_2

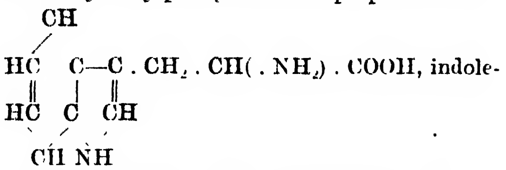
| |

CH . OH CH . COOH, hydroxy-a-pyrrolidine-

NH

carboxylic acid, heterocyclic compounds discovered by Fischer in 1901.

Guggenheim has separated from Vicia faba 3 : 4-dihydroxy-phenyl α-amino-propionic acid.



indole-α-amino-propionic acid or tryptophane, another heterocyclic compound discovered by Hopkins and Cole. Ellinger and Flamand synthesised this body in 1907.

Braconnot obtained glycine as a cleavage product of proteins in 1820, and Wohler showed afterwards that it unites with benzoic acid to form hippuric acid:

$$C_6H_5.CO.OH + H\ NH.CH_2.COOH$$
$$H_2O + C_6H_5CO.NH.CH_2.COOH.$$

Nencki considers the formation of urea as analogous to this synthesis.

Glycine contains an asymmetric carbon atom (attached to NH_2), and is accordingly optically active.

It further unites with cholic acid to form glycocholic acid of bile. By fusing glycine with urea at 230° Horbaczewski produced uric acid after Strecker had shown that heating uric acid with HCl in a sealed tube to 170° gave rise to glycine, CO_2 and NH_3. Wiener showed that glycine is produced from uric acid when administered to a rabbit.

The biochemical history of leucine, tyrosine, glutamic acid, histidine, arginine, and lysine—indeed, of all the above bodies—is teeming with interest, but obviously outside the scope of these brief observations.

It is clear that the organism must receive in its food all the elements of which its tissues are composed. This fact suggests such questions as: What becomes of a compound after it is introduced into the body; in what manner is it broken down; in what form is it finally excreted—in a word, what are the chemistry and physics of cell metabolism? Of the nature of the substances entering the body we know a little; of the nature of the substances leaving the body as excretions we know also a little; but of many of the intermediate transformations we know nothing; and of the ultimate cause of metabolism we cannot even guess. This unknown land, however, holds the richest rewards for those who can enter in and take possession.

When a protein, such as egg-white, gluten of wheat, etc., is acted on by an appropriate enzyme in the presence of water, the large complex molecule breaks down into smaller molecules. Under optimum conditions this cleavage goes on until crystalline amino- acids are formed. *In vitro* this cleavage requires the application of much more energy and a longer period of time than in the alimentary canal. In the latter, cleavage does not commence until the protein has reached the stomach, where it is subjected to the action of hydrochloric acid and pepsin. The view is generally accepted that in healthy conditions of the stomach proteins pass through the hydrolytic stage of proteoses to that of peptones, and only so far. It has been demonstrated that if gastric digestion be allowed to proceed long enough, bodies of the nature of amino- acids (abiuret products, that is, bodies which no longer give the biuret reaction) are formed. This stage of digestion need not be considered, as even under the most favourable conditions *in vitro* it requires many weeks for completion. Zuntz states that three-fifths of the products of protein digestion in the stomach enter the duodenum as peptones and two-fifths as proteoses. He shows that the condition in which the food is eaten influences the degree of digestion. Thus when a dog is fed with cooked beef there is more proteose present than when the beef is ingested raw. Further, he finds that when the pancreas is thrown out of action digestion in the stomach is more complete—that the stomach is capable of taking on an increased compensatory digestion.

Fischer and Abderhalden have shown that gastric digestion is to be regarded as preliminary to pancreatic (tryptic) digestion, since the latter takes place much more quickly and completely when the protein has been previously subjected to the action of pepsin and hydrochloric acid. They find, in the case of caseinogen, that phenylalanine and proline are present in digests previously acted on by gastric juice, but if pancreatic digestion be carried out alone the stage of amino- acids is not reached. In the duodenum trypsin acts on all forms of protein passing from the stomach, and is assisted by another enzyme—erepsin—secreted by the intestinal mucosa.

Formerly it was considered that proteoses and peptones were the end-products of digestion, but it is now known that digestion proceeds to the formation of polypeptides and mono-amino- and di-amino- acids. Abderhalden and his pupils have fed animals on meat, caseinogen, gliadin, etc., and isolated and estimated by weight tyrosine, glutamic acid, and other amino-acids from the duodenal digest. This cleavage proceeds at a much greater rate in the intestine

than *in vitro*, even under the influence of the most active enzymes. It appears that in experiments *in vitro* the enzymes in time combine with the products of their own activity and so become inactivated, whereas in the intestine, as the amino- acids are continuously removed from the field of action by absorption, there is little opportunity for such combination.

For a time Hofmeister, Neumeister, and others thought that peptone on absorption was taken up by the leucocytes, or epithelial cells of the intestinal wall, reconverted into protein and conveyed to the tissues. Others denied this, affirming that no trace of peptone had ever been found in the tissues, blood or lymph, even at the height of digestion, and that when peptone is injected into the blood it is quickly removed as waste matter.

Cohnheim tried to isolate synthesised protein from the intestinal wall, and found that the peptone reaction disappeared, not because synthesis had taken place, but because further cleavage into crystalline bodies had been effected. He isolated erepsin, and proved that with the exception of caseinogen and fibrin it could not attack native proteins, but that proteoses and peptones were readily converted into their constituent amino- acids; he isolated leucine, tyrosine, lysine, histidine and arginine.

Attention had been directed to the fact that certain amino- acids, viz., asparagine, leucine and tyrosine, in the presence of carbohydrate, could be regenerated into protein in plants; Salkowski and Leube suggested that leucine and other similar compounds were in like manner synthesised into protein in animals.

After many experiments, and much discussion, the conclusion has been reached that there is no definite evidence of the existence of proteose or peptone in the blood.

In what form, then, does protein enter the organism? Two schools make reply to this question: Abderhalden and his friends hold that synthesis takes place in the intestinal wall with formation of coagulable protein, and assert that amino- acids have not in their opinion been clearly demonstrated in the blood. Another set of observers claim that absorption takes place in the form of amino- acids.

There is no direct evidence which definitely determines the form in which digested proteins enter and travel in the blood.

The digestion and absorption of protein is followed by a large and rapid rise in the output of urea in the urine, and by a marked increase in ammonia in the portal vein. Is this deaminisation intended to preserve the concentration of amino- acids at a constant level, allowing a selected portion to pass to the tissues for architectural repair? Is it that certain amino- acids, *e.g.*, glutamic acid in gliadin, are in excess and must be eliminated? Since tissue proteins differ from one another qualitatively and quantitatively, it is argued that if the material absorbed were uniform—coagulable protein—each tissue, each cell, would individually have to break down the common pabulum in order to acquire its specific needs, and, whilst this work might be conceivably possible through the action of intracellular proteolytic enzymes, still the magnitude of it would be so great and the end so purposeless as reasonably to negative the hypothesis of immediate resynthesis. What becomes of the superfluous amino- acids if the resynthesis theory be correct? Why are they not found in the blood? Further, what is the explanation of the large increase in urea and ammonia in portal blood following protein digestion?

Inability to detect amino- acids in the blood does not prove that they are not present; and it is easier to assume with Pflüger that amino-acids, or groups of amino- acids, circulate in the bloodstream at a rapid rate, and that each cell, each tissue, draws from the fluids which bathe it the individual specific groups which it requires. The small quantities of amino- acids present relative to the whole volume of blood and the rate at which they circulate, and are absorbed, may well render it difficult to detect them.

Zuntz, Muller and others have shown that in the vegetable kingdom amides are built up into protein by certain bacteria. In this way Müller produced about 10 per cent. protein and 40 per cent. peptone from asparagine.

Much work has been done with a view to determining whether amide nitrogen alone, or in association with carbohydrate, can take the place of protein nitrogen in (1) adult animals, so as to maintain nitrogen equilibrium, and (2) in growing animals so as to maintain growth. The results are conflicting. Working with adult rats, I have in no instance been able to maintain N-equilibrium by feeding asparagine and carbohydrate, and the loss in N was greater when asparagine alone was fed. In the case of young white rats, asparagine, with or without carbohydrate, not only failed to effect growth, but in every case led to rapid loss of flesh. Control animals from the same litter were used in each set of experiments, and a normal fat ration was supplied in all cases.

Voltz, some eight or nine years ago, claimed

that acetamide and ammonium acetate were capable of effecting a retention of N in dogs; and that in ruminants these bodies could replace two-thirds of the protein of the food. My experiments in feeding white rats, both adults and young animals, with acetamide and ammonium acetate have failed to confirm the findings of Voltz.

Practically all the amino-acids with which we are acquainted have been found in the digestion of proteins in the intestine of the higher animals by one or other of the many workers in this field, in small quantities in some cases it may be, but in others in quantities of considerable size. That these bodies can no longer be considered as so much waste material is now clear, inasmuch as they are known to be able to take the place of proteins as foods, and when absorbed are as completely oxidised as proteins. Further, considered as sources of energy, they are more valuable than proteins. A gramme of tyrosine has been shown to yield practically 6 calories, and a gramme of leucine 6·5 calories, as against 4·1 calories yielded by a gramme of coagulable protein. Animals have been kept in nitrogenous equilibrium for many days without the ingestion of any protein, but instead the finished products of the tryptic digestion of proteins in which no biuret reaction could be detected.

It is of interest to note that certain products of acid hydrolysis are not absorbed. Acids can carry the hydrolysis of proteins further than proteolytic enzymes; so, it is assumed that certain linkages are broken by acids which are left intact by enzymes, and that the organism is unable to couple again the severed bonds. Again, in the case of racemic amino- acids, the organism is only capable of dealing with the body which occurs in nature, the optical isomer remaining unabsorbed and appearing later in the urine.

Reference may now be made to some experimental work on the rapidity of gastric digestion in the human subject.

Hot trichloracetic acid precipitates native proteins from blood serum, filtered gastric digest, urine, etc., but not proteoses, peptones, or amino- acids. Saturated $ZnSO_4$ solution precipitates proteoses, but not peptones or amino-acids. A 7 per cent. solution of tannic acid also precipitates proteoses, but not peptones or amino- acids and in certain cases is preferable to $ZnSO_4$ solution. A solution composed by weight of 10 parts H_2SO_4, 40 parts phosphotungstic acid, and 50 parts water, precipitates proteoses, peptones, and diamino- acids, but not mono-amino- acids. The method of separating and estimating amino- acids is mostly a lengthy process, involving evaporation in vacuo at a low temperature, saturation with HCl gas, solution in alcohol, etc., and even in the cases where comparatively large quantities of particular amino- acids are present the process gives only approximately correct results. In gastric work, with but very few exceptions, no such method is needed.

Before commencing an investigation, it is well to make some preliminary estimations with definite quantities of purified products, not only to be certain of the purity and normal activities of the various reagents used, but also to test one's own ability in securing accurate results. In this work I have found that by careful scrutiny of the individual reactions results defaulting by 2 or 3 per cent. may be reduced to well within 1 per cent. of error.

The following are transcribed from my case-book :—

P = native protein, P_1 = proteose, P_2 = peptone.

1. Healthy man æt. 30 had test breakfast of caseinogen mixed with water and a small quantity of NaCl on four separate occasions. On the first occasion the entire gastric contents were drawn off at the end of one hour; on the second occasion at the end of two hours; on the third occasion at the end of three hours; and on the fourth occasion at the end of four hours. The relative percentage proportions of P, P_1, and P_2 were as follows :—

1st hour.			2nd hour.			3rd hour.			4th hour.		
P	P_1	P_2	P	P_1	P_2	P	P_1	P_2	P	P_1	P_2
70	21	9	65	18	17	56	20	26	52	19	29

The same subject had later four test breakfasts of red meat, freed from fat and white fibrous tissue, slightly grilled, with a small quantity of NaCl and a glass of hot water.

The relative percentage proportions of P, P_1, and P_2, at the end of one, two, three and four hour periods respectively were as follows :—

1st hour.			2nd hour			3rd hour.			4th hour		
P	P_1	P_2	P	P_1	P_2	P	P_1	P_2	P	P_1	P_2
76	14	10	70	16	14	60	19	21	54	20	26

2. Man æt. 38. Suffering from gastric catarrh. Same procedure.

	1st hour.			2nd hour			3rd hour			4th hour.		
	P	P_1	P_2	P	P_1	P_2	P	P_1	P_2	P	P_1	P_2
Caseinogen	92	8	0	86	12	2	85	8	7	84	8	8
Red meat	93	7	0	88	8	4	86	7	7	85	8	7

3. Man æt. 38. More pronounced symptoms of gastric catarrh.

	1st hour.			2nd hour.			3rd hour.			4th hour.		
	P	P_1	P_2	P	P_1	P_2	P	P_1	P_2	P	P_1	P_2
Caseinogen	88	8	4	80	12	8	70	15	15	64	16	20
Red meat	90	6	4	82	11	7	68	20	12	66	16	18

I have been sufficiently fortunate in securing the analyses of three cases of stomach contents, vomited after ingestion of a meal by patients in a condition of exhaustion following muscular activity. The stomachs were washed with warm water at the time of vomiting, and the washings added to the vomits.

Case 1, man æt. 27. Vomiting occurred $4\frac{1}{2}$ hours after a mixed meal: $P = 95$ per cent., $P_1 = 3$ per cent., $P_2 = 2$ per cent.

Case 2, man æt. 34. Vomiting occurred $3\frac{1}{4}$ hours after a mixed meal: $P = 89$ per cent., $P_1 = 5$ per cent., $P_2 = 6$ per cent.

It is clear that, in certain cases, extreme muscular exhaustion can almost blot out gastric digestion.

In the Case 3 of gastric catarrh of more pronounced symptoms, gastric digestion is better than in the case of less pronounced symptoms. On referring further to my case-book, I find that in this condition there is no relation between severity of symptoms and degree of digestion.

The figures in the first case above do not quite agree with the findings of Zuntz; still, they are within measurable distance of his proteose-peptone ratio.

Considerable attention has been paid to the subject of parenteral administration of proteins. Some observers state that whilst the whole of the protein injected intravenously, subcutaneously, or otherwise, cannot be recovered from the urine, still the output of N in the urine is increased. The view is at present entertained that a large proportion of certain proteins introduced parenterally finds its way into the intestine, where it is either digested in the ordinary way or eliminated in the faeces. Indeed, the subject of intestinal secretion generally appears to be of considerable importance in connection with several problems of absorption and excretion. That individual cells of various tissues contain proteolytic enzymes has been definitely proved; but whether any considerable quantity of native protein is digested outside the alimentary canal in normal states of the organism at least is doubtful.

Proteins destitute of tryptophane are not capable of supporting nitrogen equilibrium. Tryptophane occurs in other interesting connections in the organism, more especially in connection with alkaline fermentation in the lower gut.

Before proceeding to study the catabolic changes which occur in the protein molecule, it is necessary to review some facts connected with the molecular structure of carbohydrates and fats, and some of the changes which are effected in these molecules. Von Bäyer's suggestion that the synthesis of sugar in plants commences with the reduction of CO_2 in the air, through the agency of the pigment chlorophyll in the presence of sunlight, is widely accepted. According to this view, the reduction product, formic aldehyde, undergoes condensation into a large molecule of sugar. Whilst the proof that this actually takes place has never been given, the hypothesis is so conformable to what we know of the chemistry of the bodies concerned that the conclusion that it is correct is almost irresistible.

The condensation assumed is a general reaction with aldehydes known as the aldol condensation, from aldol

$$\begin{array}{ccccccc} & & OH & & & & O \\ CH_3 & . & C & . & CH_2 & . & C \\ & & H & & & & H, \end{array}$$

the product of condensation of two molecules of acetic aldehyde

$$\begin{array}{ccc} & & O \\ 2CH_3 & . & C \\ & & H. \end{array}$$

The condensation of six molecules of formic aldehyde produces a hexose

$$\begin{array}{cccc} & O & & \\ 6H & C & = & C_6H_{12}O_6. \\ & H & & \end{array}$$

These reactions are almost isothermic, and easy of comprehension once formic aldehyde is produced.

In the animal organism we meet with carbohydrate in the forms of dextrose, lactose and glycogen. The condensation of glucose to form glycogen has been experimentally demonstrated in rabbits; but how the change is brought about remains still a mystery. It is probable that it is one phase of a reversible enzymic reaction.

All starches and vegetable sugars ingested undergo, partially in the mouth and fully in the upper segment of the small bowel, hydrolysis into dextrose. In the liver glycogen is hydrolysed into dextrose. Lactose is hydrolysed into dextrose and galactose. These last differ stereochemically:—

$$\begin{array}{ccccccccccl} & & OH & & OH & & H & & OH & & \\ CH_2OH & . & C & . & C & . & C & . & C & . & COH \text{ dextrose,} \\ & & H & & H & & OH & & H, & & \end{array}$$

$$\begin{array}{ccccccccccl} & & OH & & H & & H & & OH & & \\ CH_2OH & . & C & . & C & . & C & . & C & . & COH \text{ galactose.} \\ & & H & & OH & & OH & & H & & \end{array}$$

Carbohydrate combinations occur in certain proteins, in nucleic acids, and in certain fatty acid compounds. Nucleic acids in combination with some form of protein in cell nuclei, play perhaps the most important role of all the constituents of living protoplasm; their molecules invariably contain some form of carbohydrate, for the most part a pentose. Bang proved that the pentose was a constituent of the nucleic acid of pancreatic cells, and not of the associated protein, and a few years later Neuberg demonstrated the sugar to be a l-xylose. The same sugar has been found in the liver.

Xylose occurs in straw, etc., and forms the skeletal material of many plants; it is accordingly more or less outside the range of activity of plant ferments. Like other pentosans, xylose resists the action of alkalies, and requires for hydrolysis prolonged heating with mineral acids. It can be formed from dextrose by the degradation method of Wohler, wherein a carbon group is eliminated. The oxime of glucose is heated with strong NaOH and converted into the nitrile of gluconic acid. Further heating eliminates HCN, and leaves the pentose. By this general reaction a pentose may be converted into a tetrose, and finally, by repetitions of the process, formaldehyde may be reached.

Xylose may also be obtained from glucose: (1) By oxidation of the terminal alcoholic group in glucose into glycuronic acid; and (2) by subjecting the glycuronic acid to the action of certain bacteria, which split off CO_2, leaving l-xylose.

Starch and sugar enter so largely into the food of man that on the surface it might appear that the carbohydrates of the body are formed directly from these and from these only. This is not the case. In health the amount of sugar found in the blood practically never exceeds 0·2 per cent., or 10-11 grammes. In diabetes, patients have been known to eliminate 1,200 grammes of sugar in the day; and in experimental forms of the disease set up in dogs by extirpation of the pancreas, or by administration of the drug phlorrhizin, an even larger proportion of sugar has been excreted. Pflüger records an experiment in which, in two months, 3,000 grammes of sugar were excreted by a dog fed solely on protein food. The greater portion at least of this sugar must have been formed from something which was not carbohydrate. If not from protein, it must have been from fat. It is now definitely known that diabetics eliminate sugar after all administration of sugar is stopped, and that the ingestion of protein increases the output of sugar, whilst fat has no effect.

A large amount of information has been obtained concerning urinary nitrogen and sugar elimination in the meat-fed and fasting diabetic animal. The dextrose : nitrogen ratio (D : N) is an index to the quantity of sugar derived from protein. Nitrogen and dextrose double in quantity after ingestion of meat, but their ratio remains the same as in starvation. Since one gramme of urinary nitrogen represents 6·25 grammes of protein, and since there is simultaneously an average elimination of 3·65 grammes of dextrose in phlorrhizin diabetes, it is plain that the sugar derived from meat amounts to 58 per cent. by weight of the meat metabolised, and may contain over 52 per cent. of its available energy. Reilly, Nolan and Lusk have shown that the elimination of sugar takes place before that of the nitrogen. After the ingestion of 500 grammes of meat, the D : N ratio rose immediately from 3·4 to 1·9 and then fell, so that in successive three-hourly periods the ratio was 3·9, 2·9, and 2·9.

Minkowski showed that in depancreatised dogs, whether fasting or fed with meat, the elimination of dextrose : nitrogen (D : N) was as 2·8 : 1 The ratio in man is higher, the value assigned by Stiles and Lusk being 3·65 : 1.

Dextrose has been shown to be formed from asparagine, glycocoll, alanine, and other amino-acids. Neuberg showed that alanine is converted into lactic acid by hydrolysis with elimination of ammonia, which last is converted into urea. Lusk and Mandel showed that d-lactic acid is completely converted into dextrose in the organism:—

$$\underset{\text{alanine}}{CH_3.CHNH_2.COOH + H_2O} \longrightarrow \underset{\text{lactic acid}}{CH_3.CHOH.COOH} + NH_3.$$

It is probable that glutamic acid, aspartic acid, and serine yield glucose in the same manner.

Whilst the molecular weight and general structure of the carbohydrate molecule may remain the same, the smallest change in the space arrangement of the groups attached to the chain of carbon atoms is sufficient to alter profoundly the nature of the chemical activities. Pasteur showed that Penicillium glaucum assimilated only the right-handed tartaric acid from solutions of racemic acid, leaving the left-handed variety untouched. It is now known that both varieties are attacked, but that the velocity of the biological reaction in the case of the left-handed variety is so great relatively as

quite to overshadow the other reaction; moreover, there is evidence to show that the two varieties are attacked in a different manner. Again, it is possible to obtain one or other of the components of a racemic substance by employing appropriate organisms, *e.g.*, d-mandelic acid is obtained from the racemic substance by the growth of Penicillium glaucum, and l-mandelic acid by the growth of Saccharomyces ellipsoideus. When yeasts act on glucose, d-glucose only is converted into alcohol and CO_2, l-glucose remaining intact. Throughout the group of hexoses, only the d-isomeride is attacked. The four natural glucoses which are fermentable, viz., glucose, mannose, fructose, and galactose, are all d-compounds. Any species of yeast which ferments any one of the three sugars, dextrose, fructose, and mannose, will ferment the others. It has been demonstrated that the temperature coefficient of these fermentations is similar throughout. The ease with which these sugars can be converted one into another, through the influence of alkalies, has led to the assumption of an enolic form common to all —

$HOHC:COH.CHOH.CHOH.CHOH.CH_2OH.$

If H_2O be added to this it passes into an aldehydrol—

$HO.CHOH.HCOH.HOCH.HCOH.HCOH.CH_2OH.$

If, now, H_2O be taken away glucose appears—

$CHO.(HCOH)_4CH_2OH.$

There is no doubt that the transformation of sugar into alcohol and CO_2 is a succession of reactions, and possibly the formation of the enol is the first step. Afterwards either the same enzyme or a new enzyme breaks off the carbon atoms united by the double bond at the end of the chain. This last assumption is supported by the fact that certain bodies, such as gluconic acid, methyl glucosides, and a number of esters, differing from sugar only in the groups attached to the terminal carbon atom, are unfermentable.

Bacillus coli produces twice as much alcohol from mannitol as from glucose; it is reasonable to suppose that the difference is due to the group $CH_2OH.CHOH$, which is contained twice in mannitol, but only once in glucose.

Bertrand's sorbose bacterium has been shown to oxidise aldoses to the corresponding acids, whilst it converts alcohols into ketones; glucose becomes gluconic acid, *i.e.*, $C\begin{smallmatrix}\diagup O\\ \diagdown H\end{smallmatrix}$ becomes $COOH$; and sorbitol becomes sorbose, *i.e.*, $CHOH$ becomes CO.

It is unnecessary further to multiply examples in order to conclude that configuration in space of the elements of the carbohydrate molecule is of the first importance in determining the direction of many biological reactions.

Various animal and vegetable substances, whilst differing widely in physical characters, possess in common in their chemical constitution the radicals of fatty acids. Some of these are known as fats, some as oils, some as waxes, and some as "lipoids." Those members of the group which form foods are mostly esters of the triatomic alcohol glycerol. If solid at the ordinary temperature they are known as fats; if liquid, as oils. These esters may contain one, two, or three fatty acid radicals. The position of the fatty acid radical frequently leads to isomerism

$CH_2.OH$
|
$CH.OH$ glycerol.
|
$CH_2OH.$

$CH_2.O\ OC.C_3H_7$
|
$CH.OH$ monobutyrin, the α compound.
|
$CH_2\ OH.$

$CH_2.OH$
|
$CH.O\ OC.C_3H_7$ monobutyrin, the β compound.
|
$CH_2.OH$

The entrance of two fatty acid radicals gives —

$CH_2.O\ OC.C_3H_7$
|
$CH.O\ OC.C_3H_7$ dibutyrin, the $\alpha\beta$ compound.
|
$CH_2.OH.$

$CH_2.O\ OC.C_3H_7$
|
$CH.OH$ dibutyrin, the $\alpha\alpha$ compound.
|
$CH_2.O\ OC.C_3H_7$

The entrance of three fatty acid radicals gives—

$CH_2.O\ OC.C_3H_7$
|
$CH.O\ OC.C_3H_7$ tributyrin.
|
$CH_2.O\ OC.C_3H_7$

The H of the hydroxyl group in glycerol may be replaced by three entirely different fatty acid radicals, and this is the case in many naturally occurring fats. Again, phosphoric acid and fatty acids may be united to the same glycerol molecule, and since phosphoric acid is tribasic,

the acid hydroxyl groups not held by the glycerol may combine with alcohols, bases, etc. Further, we meet with mixtures of several glycerides with cholestrol, soaps, etc., so that there exists a large number of ill-defined fatty bodies with highly complex constitutions. Lastly, certain compounds of fatty acids containing phosphorus also contain nitrogen, and others a carbohydrate group.

Fatty acids are *saturated*, with the formula $C_nH_{2n}O_2$, an*d* *unsaturated*, with varying formulæ, but with the number of H atoms always less than that of the saturated acid containing the same number of C atoms.

In the saturated fatty acid series capric acid containing ten carbon atoms divides the series into two groups in respect of an important physical property. This acid and all the acids below it are easily distilled with steam, forming the "volatile fatty acids." The acids immediately above capric are volatile only in traces.

The unsaturated acids contain one or more pairs of C atoms united by double bonds. They are thus able to combine with halogens and become saturated. In the higher members of the series the double bonds may occur at different points in the chain, giving rise to different properties. The position of the double bond may be determined in certain cases by use of the fact that an unsaturated bond is liable to become saturated by the entrance of OH groups, whereby further oxidation breaks the chain at this point. Or the two unsaturated C atoms may link up two different arrangements of the same group, thus

$$\begin{array}{ccc} -C-H & \qquad & -C-H \\ \| & & \| \\ -C-H & & H-C- \end{array}$$

That the double bond in oleic acid is in the middle of the chain has been surmised from the following reactions –

Alkaline permanganate of potassium at high temperatures oxidises oleic acid to azelaic and pelargonic acids; at low temperatures to dioxystearic acid; the low-temperature reaction may be represented thus—

$$\begin{array}{ccc} CH_3 & & CH_3 \\ | & & | \\ (CH_2)_7 & & (CH_2)_7 \\ | & & | \\ H\ C\ OH & -H_2 \rightarrow & CO \\ | & & | \\ H\ C\ OH & & H\ C\ OH \\ | & & | \\ (CH_2)_7 & & (CH_2)_7 \\ | & & | \\ COOH & & COOH, \end{array}$$

and the high-temperature reaction thus

$$\begin{array}{ccc} CH_3 & & CH_3 \\ & & | \\ \cdot & & (CH_2)_7 \\ & & | \\ H\ C\ OH & -2H_2 \rightarrow & CO \\ | & & | \\ H\ C\ OH & & CO \\ | & & | \\ (CH_2)_7 & & (CH_2)_7 \\ | & & | \\ COOH & & COOH, \end{array}$$

the latter body splitting into –

CH_3 $(CH_2)_7$ $-COOH$ pelargonic acid, and $COOH-(CH_2)_7-COOH$ azelaic acid.

The action of ozone on oleic acid produces finally the same cleavage products.

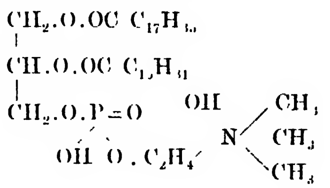
The interest of these reactions will be apparent when we come to discuss the oxidation of fatty acids in the body. On boiling fats with alkalies glycerol separates, and fatty-acid salts of the alkalies are formed as soaps. Under the action of the enzyme lipase contained in the alkaline pancreatic juice the same reaction occurs, but to a much less extent than was formerly supposed, in that the periodic entrance of acid chyme from the stomach lessens the alkalinity of the duodenal contents and thereby prevents the formation of soaps. Further, such soaps disappear somewhat after formation through hydrolytic dissociation. Sodium palmitate yields a clear jelly-like solution when treated with hot water. If this solution be diluted with water it becomes cloudy owing to liberation of free fatty acid and alkali. The free acid can be removed by shaking with toluene and estimated. The alkali set free can also be estimated by salting out the unhydrolised soap and free fatty acid together, dissolving the curd in alcohol and titrating with standard alkali. This hydrolytic dissociation can be prevented by the addition of alcohol or glycerol It can also be prevented by excess of alkali, as it is the liberated alkali which limits the dissociation. With volatile bases, such as ammonia, this limit falls, and the soaps are accordingly unstable.

Acids less saturated than oleic occur in the drying oils, in the liver of the cod, and the liver and other organs of mammals. Those found in animal tissues are mostly in combination with glycero-phosphoric acid. Drying oils take up oxygen when exposed to the air and become saturated as varnishes.

The more unsaturated bonds that exist in a fatty acid complex the more readily it takes up oxygen and the more unstable it is. It is a significant fact that in those tissues in which

fats are burnt, not merely stored, the fatty acids are unsaturated—that is to say, they have been prepared for combustion—whilst the stored fats are saturated and inactive. Rancidity in fats is produced by hydrolysis of the glycerides followed by oxidation of the free fatty acids in the presence of traces of moisture; lower volatile and oxyacids appear in the process. Rancidity in butter prevents complete hydrolysis in certain cases of gastro-intestinal catarrh, as may be determined by estimation of the glycerides in the faeces.

Certain compounds of fatty acids containing phosphorus and nitrogen, and others containing nitrogen, are met with. To the first class belongs lecithine, which was prepared by Diakonow from yolk of egg by shaking with ether. Lecithine is optically active owing to its unsymmetrical glycerophosphoric acid. Erlandsen prepared lecithine from heart muscle which possessed an iodine value of 110. Glycerophosphoric acid is obtained as a barium salt when lecithine is saponified with baryta; this salt is soluble in water, but insoluble in absolute alcohol. The reaction is not quantitative. Lecithine gives Pettenkofer's reaction with H_2SO_4 and sugar through its contained unsaturated fatty acids. Hoppe-Seyler hydrolysed lecithine and studied the cleavage products, which he found to be fatty acids, glycerophosphoric acid and choline. He concluded that in glycerophosphoric acid, through one of the OH groups of glycerol, an ester of phosphoric acid is formed in which two alcoholic OH groups are free and two acid OH groups are free. Two fatty acid radicals form ester connections with the alcoholic hydroxyls, and choline unites with one of the acid hydroxyls. Choline could unite with an acid OH by its alcoholic OH or by its basic OH The former union is accepted and the structure of lecithine is represented as—



in which other fatty acid radicals may take the places of those in the formula.

The fatty acids recovered from lecithine by Hoppe-Seyler were thought to be stearic, palmitic and oleic. But several different findings have appeared in recent years for the iodine values of the fatty acids of lecithine. Indeed, it is problematical if such a body as the above definitely exists, since neither the yield of choline nor of glycerophosphoric acid is constant.

By the methods of Farnsteiner and Varrentrapp non-volatile fatty acids can be separated into liquid unsaturated and solid saturated. In a general way the lead salts of unsaturated acids are soluble in ether, whilst those of saturated acids are insoluble.

Saturated acids obtained from the lead salts insoluble in ether may be resolved into their constituents by fractional precipitation of barium or magnesium salts and removal of the free acids by HCl and petroleum ether. Or they may be resolved by fractional distillation of their ethyl esters in vacuo.

Unsaturated acids may be obtained from the lead soaps soluble in ether by bromination, or their identification may be established by oxidation of the acids formed.

Some of the characters and properties of fats I have dealt with elsewhere

The fats of animals are mostly the fats of their foods. The fat of an individual may be altered by changing the fat in its food. The fat of an animal fed on linseed oil contains linolein. Fats and oils occur in plants in ripe seeds. Seeds before ripening contain large quantities of carbohydrates but no oils. It is reasonable to suppose that the fats are formed from the carbohydrates. The formation of fatty acids from carbohydrates has been proved in animals. To accomplish this it would appear that an alcoholic OH is reduced and its O transferred to another carbon atom thus—

$CH_2OH.CHOH.COH \rightarrow CH_3.CHOH.COOH.$

Nef showed that the same treatment with weak alkalies produces lactic acid from glyceric aldehyde and glucose. Embden produced lactic acid from glycogen (hence from glucose) by perfusing a liver rich in glycogen. Conversely, Mandel and Lusk have shown that lactic acid administered to a diabetic animal is converted into glucose. Accordingly lactic acid is an important intermediate product in the metabolism of carbo-hydrates.

Lactic acid is produced from sugar by the enzymes of various bacteria. Pasteur showed that certain bacteria which effect the butyric acid fermentation of sugar produce butyric acid from lactic acid as readily as from sugar. Nencki explained the synthesis necessary to convert lactic acid into butyric acid by assuming that lactic acid breaks down into the lower aldehyde (acetaldehyde), hydrogen and carbon dioxide. Two molecules of aldehyde condense

to form aldol, a four-carbon chain, and this when reduced and oxidised yields butyric acid —

$$\begin{array}{ccccccc} CH_3 & & CH_3 & & CH_3 & & CH_3 \\ | & + & | & \rightarrow & | & & | \\ COH & & COH & & COH & & CH_2 \\ & & & & | & \rightarrow & | \\ & & & & CH_2 & & CH_2 \\ & & & & | & & | \\ & & & & COH & & COOH. \end{array}$$

This synthesis would appear to be good for the formation of acids with six, eight, etc., carbon atoms, but not for acids with five, seven, etc., carbon atoms. It is significant in this connection that fatty acids with more than six C atoms produced in nature have an even number of carbon atoms attached in a straight chain.

Pinkus and Wohler suggested that in the formation of lactic acid from glucose glyceric aldehyde was first formed

$$CH_2OH.(CHOH)_4.COH \rightarrow 2CH_2OH.CHOH.COH$$

then pyruvic aldehyde

$$CH_2OH.CHOH.COH \rightarrow CH_3.CO.COH$$

and finally lactic acid

$$CH_3.CO.COOH \rightarrow CH_3.CHOH.COOH.$$

This fascinating theory appears to derive some support from such evidence as: (1) Dextrose yields the osazone of pyruvic aldehyde when treated with alkalies and phenyl hydrazine: (2) Alkalies convert pyruvic aldehyde into lactic acid; (3) Dihydroxy acetone on distillation with H_2SO_4 yields pyruvic aldehyde: (4) The work of Windaus suggesting the view that disaccharides are formed from glucose by synthesis from glyceric aldehyde and lactic acid.

ENGINEERING OPENINGS IN CHINA.

Gold is found in many parts of the province of Szechuan, China, but not always in paying quantities. According to a recent report from Chungking, the most important mine in Szechuan that has thus far been opened is located at a very mountainous place called Maha, which lies in the south-western corner of this province about fifty miles north-west of Ningyuanfu. The Government is very anxious to develop the Maha mine to the fullest possible extent, and is now undertaking a thorough reorganisation. Two Chinese engineers, who studied mining engineering in Belgium, are employing a corps of trained assistants and about 1,200 miners in the mining work at Maha. Both the Government at Peking and the provincial authorities are giving them every encouragement, and there is reason to believe that this project will finally succeed. New mining machinery is needed to carry on this work to the best advantage. This opportunity is exceptional, inasmuch as the installation of a plant at Maha would doubtless result in further business, since not only gold is found in the western part of this province, but antimony, iron, lead, silver, and copper also occur in considerable quantities, and will be mined eventually by up-to-date methods.

H.M. Consul-General at Yunnan-fu remarks that the great drawback to British trade in the province of Mengtsu hitherto has been the lack of any British firm to represent United Kingdom manufacturers and push the sale of their goods; but there is a good prospect of this deficiency being remedied in the near future. The present time, he says, is exceptionally favourable for such an enterprise, as the two German firms which have hitherto supplied local buyers with machinery, etc., can now obtain no further supplies, and the Chinese would welcome the establishment of a British firm in Mengtsu. There are inquiries for irrigation pumps, electric light machinery, flour and rice mills, material for the installation of waterworks in Yunnan-fu, locomotives and trucks for the Pishihchai Railway, and other items. but these can only be dealt with by a man on the spot who is prepared to make a contract for the goods delivered c.i.f. at Haiphong, possibly assist to some extent in their erection, and arrange the question of exchange.

According to a recent official report, the district of Tzeliuching, which lies in the south-central part of Szechuan, some fifty miles north of Suifu, is the most important industrial centre in West China. This is true not only as regards its present state of development, but also as regards its potentialities and possibilities. Tzeliuching at no distant date will place larger orders for foreign machinery than any other city in this part of China. Machines for drilling new wells, for pumping up the brine, and for evaporating the salt are of first importance. Simple hoisting engines to supplant the water buffaloes should enjoy a large sale. Gas stoves and burners and engines using gas for fuel could also be introduced. As the salt wells are operated night and day, there is an excellent opportunity for the sale of electric-lighting plants. Telephone apparatus is also in demand, and mine pumps and machinery are needed in the coal-fields.

Writing on the resources of the Kaihsien District, the American Consul at Chungking, Szechuan Province, says that while there is not much chance of introducing textile machinery at the present time, if factories are started and the industry develops to any extent, there ought to be a market for cheap looms of simple construction. Mining machinery might even now be sold to advantage, both for coal and iron, and a modern smelter might be established very profitably at Ma-chia-kou or Wen-tang-ching. With the cheap labour and the extensive deposits of iron and coal, there is no reason why the Kaihsien District should not become in the course of time an important manufacturing and industrial centre.

He also points out that, as the district about Chengtu develops, there will be an increasing demand for foreign machinery. Mining machinery is needed in the development of the region west of Kwanhsien, where lead, coal, silver, and copper deposits are said to be extensive. There is also a demand for machinery for the scientific refining of salt and sugar, and for the manufacture of paper, shoes, soap, candles, and many other articles. Modern sawmill machinery will eventually be introduced. Machinery for silk and cotton weaving could be used to advantage; much of the Thibetan wool that comes from Tachienlu to Chengtu could be made into fabrics at the latter city, where labour is cheap and water-power available.

THE CHANK FISHERIES OF INDIA.

Mr. James Hornell, the superintendent of pearl and chank fisheries to the Government of Madras, has written an interesting monograph on "The Sacred Chank," from which the following is taken:—

Five distinct chank fisheries are carried on at the present day in India. Ranked in the order of their importance they are: (a) Tinnevelly (usually called the Tuticorin fishery); (b) Ramnad (with Sivaganga); (c) the Carnatic coast (South Arcot and Tanjore); (d) Travancore; (e) Kathiawar - to which is to be added a large one in the north of Ceylon.

Without exception, the chank fishery in each of these localities is considered a royal prerogative, the monopoly of the Government; in practice this prerogative is variously exercised. In Tinnevelly the Madras Government works the fishery departmentally through an officer of the Fisheries Department. On the Carnatic coast the shells are either (in Tanjore) bought at fixed rates from the fishermen by the Customs Department on behalf of the Fisheries Department, or else (in South Arcot) the exclusive right to collect is farmed out to a renter for a term of years. The latter administration of the prerogative is also in force in Okhamandal (Kathiawar), where the Gaekwar of Baroda exercises sovereign rights in the local fishery. In Ceylon the renting system was in force until 1890, when it was abandoned in favour of an export duty. In Travancore the dues of the Government are collected in the same manner as in Ceylon. The Tinnevelly chank fishery was until lately the only one that was carried on systematically and with a definite organisation.

The more satisfactory course of the 1913-14 fishery over those of the two preceding seasons was due chiefly to the very favourable weather that prevailed from the beginning of January to the middle of May. The fishing grounds exploited during the season were those lying north-east and east of Tuticorin. The particular beds that gave the greater bulk of the shells were: (a) Vattikal Piral, (b) the neighbourhood of the Nadu Thundam par, and (c) more especially the ground called Koli Kunju-tavu, from which alone 65,086 chanks were fished.

As the beds fished had received much attention from the diving staff in 1910-11, but none in 1911-12 or 1912-13, the shells were most satisfactory in size and quality. The proportion of "wormed" shells was particularly low, being only 3,551 out of a total take of 245,308, as against 13,133 out of 158,704 in the preceding year, when beds that had not been fished for a number of years received attention. This emphasises the value of fishing the beds at regular and not too long intervals; failure to fish any bed at least once in three years entails the presence of an undue proportion of "wormed" shells. The shells fished were, as usual, graded into nine sizes—beginning with shells 4 in. or more in diameter, and diminishing by ¼ in.—by means of gauge boards, each size being stored in a separate bin.

IMPROVING TRADE PROSPECTS IN YÜNNAN PROVINCE.

In a general way trade prospects in Southern China seem to be improving. Conditions along the West River in Kwangsi Province are reported by Chinese middlemen as considerably improved compared with three months ago. There is an increased demand for cotton piece goods, and some of the considerable stocks on hand in Hong-Kong are being absorbed by this up-river trade. Cotton yarn prospects also are improving. The kerosene trade is somewhat better, though piracy has been interfering with it to a very material extent.

In Yünnan Province correspondents report considerable activity in prospect. A waterworks system for Yünnanfu is now being seriously considered, and a proposition from a British firm in Hong-Kong seems likely to be accepted. It is proposed to spend about £27,000 upon the initial enterprise. Of this amount the Government will furnish one-third and private capital two-thirds.

Talifu is agitating for an electric lighting system, and a Chinese company is being formed to furnish it. So far, capital is somewhat reluctant to come forth, writes the United States Consul-General for the Yunnan Province; but inasmuch as the city is an important one, and other Chinese cities in the province are enjoying satisfactory electric light services, with profit to all concerned, it seems probable that the new concern will be effectively organised. Modern bridges are being called for in various parts of the province, and Hong-Kong firms in a position to contract for such work have a number of propositions under consideration. However, in view of high freight rates and the increased cost of all structural steel, it is doubtful if any such work will be done for the present.

In general, the condition of Yünnan Province is reported as prosperous. The spring harvest is reported as eight-tenths good, and there is increased production of cotton over considerable areas. Some opium is still cultivated in remote places, in spite

of the inhibition of the crop by the Government at Pekin. There is considerable interference with the trade of the province by the war. The export of antimony, copper and spelter is practically stopped because, as contraband of war, the French authorities will not transport these minerals through Indo-China except for themselves and at substantially their own prices. The export of tin is also interfered with in the same way, though the export is continued by special arrangements, including the permission necessary to re-export it from Hong-Kong after refining.

SEPARATING OIL FROM WATER OF CONDENSATION.

A novel method of separating oil from water of condensation, now being used in some large mining plants in Germany, is described in *Cassier's Engineering Monthly*. In this arrangement the water is led to a deep well which is vertically divided into three compartments of equal capacity. The water of condensation, rich in oil, flows into one compartment, and is then led through pipes from the deepest part of the well into the second compartment, whence it passes into the third compartment, and is finally delivered by a centrifugal pump whose suction is also at the deepest part of the well. When the water is admitted to the well, the oil in it is either in drops or in emulsion. In the well, when the water is in a state of rest, the oil in drops separates, and can be easily collected on the surface. This oil is pure because of the heavier impurities having settled down to the bottom of the well, and can, therefore, be again used for cylinder lubrication. If, however, the water of condensation is intended for use as boiler feed-water, it must be freed also from the oil in a state of emulsion, and this is done by means of an electrolytic oil separator. In this case the water containing the oil is supplied by a centrifugal pump and first passes into one of the compartments, where it is fed between electrodes, the separation of the oil taking place under the action of the electric current. Since, however, the water of condensation, apart from the oil it contains, is a very bad conductor of electricity, its resistance is decreased by the addition of a solution of soda. It has been found that with current costing $\frac{1}{4}d.$ per kw. hour, the cost of purifying the cubic metre (say, 35·3 cubic feet) of water per hour amounts to less than one-sixteenth of a penny.

DIAMOND INDUSTRY IN THE NETHERLANDS.

The diamond trade, one of the most important of all Dutch industries, experienced in 1914 one of the most trying years in its history. Exports to the United States, its principal market, heavily declined, and general conditions were unfavourable. The increased duty put upon both rough and polished diamonds by the American Tariff Act of 1913 and the financial situation contributed to the decrease.

There was another disturbing factor in the early part of the year, that is, dissatisfaction with the business methods of the Antwerp Syndicate, which handled the supply of German rough diamonds. In April, however, the London Syndicate assumed control, the change bringing about an immediate feeling of relief. Shortly thereafter, when the conference of representatives of the principal mining concerns at London decided to limit production, a revival of trade was confidently looked for. When the war broke out, however, diamonds almost ceased to be articles of commerce, the cutting and polishing factories practically closing down. Trade was stagnant, and so remained until near the end of the year, when operations were resumed in a few establishments on a diminished scale. Work undertaken before the war had to be completed, but only a few concerns did business of any importance. True, there were transactions among the diamond brokers and dealers, but none of consequence, and the strenuous efforts of leading men in the trade to maintain a scale of prices came to naught.

It is hardly possible that there can be a revival in trade during the continuance of the present war; but in the best-informed circles the feeling prevails that the return of peace will mean new life to the trade. It is within the memory of many that after the Franco-German War it experienced a long period of prosperity. The South African War of 1899 brought hard times, but with the declaration of peace there was a surprisingly quick revival, which was only broken by the general financial crisis of 1907.

According to a report by the United States Consul at Amsterdam, the diamond industry gives employment to more than 10,000 working people—sawyers, cleavers, polishers, cutters, etc. Of this number about 9,800 are members of the Amalgamated Union of Dutch Diamond Workers, a beneficial organisation, the records of which show that at the beginning of 1914 over 5,000 of its members were out of employment, and that during the seven months preceding the war the average of unemployed was nearly 4,000. When the war began about 80 per cent. of the employees were out of work, and the remainder were on short time.

The following table shows the value of shipments of diamonds to the United States from January 1st to July 31st, and from August 1st to December 31st, in 1913 and 1914 :—

Kinds.	1913.		1914	
	Jan.-July.	Aug.-Dec.	Jan.-July.	Aug.-Dec.
	£	£	£	£
Rough .	145,611	51,420	55,766	33,741
Polished	1,580,085	457,055	899,453	132,124

In analysing the foregoing figures it might appear that the European war had but little influence on the movement of diamonds from Amsterdam to the United States, the decrease after August 1st not being so pronounced as would naturally be expected. In this connection it should be remembered that among the thousands of Belgian fugitives arriving at Amsterdam at the time Belgium was invaded were many diamond dealers, who, after bringing their stocks to Amsterdam, shipped them to the United States to be sold for the best obtainable prices.

THE DEVELOPMENT OF THE TEXTILE INDUSTRIES.

Current Conditions.—The busiest manufacturers at the present time are clearly those making goods for the direct purposes of war, be those goods what they may. Next to them rank a not inconsiderable number of producers of necessary articles, who have gained more from the suspension of foreign competition than they have lost from the total restriction of markets. Makers of goods of which the purchase can be indefinitely delayed, and manufacturers of fancy or luxury articles, have much less employment, and it cannot be a serious misstatement to suggest that production of such goods has decreased by at least one-half. Comparatively little energy is going into the production of frippery. The great bulk of the textile work done is unquestionably in response to the most solid requirements. The armies are being equipped and the home civilian population is being clothed in mainly plain and durable goods, and export is limited to the natural needs of those who rely upon British industry.

Economy in Clothing.—In their own experiences, manufacturers see little of the unthrift that is sweepingly charged against the home population. Certainly the buyers with whom they come into contact exhibit the customary cautiousness in the face of high prices, and are well disposed to defer any operations that can excusably be put off. The economy in clothing that is being enjoined upon the nation at large is being fairly well observed at their end of the trade. For instances of extravagance one has commonly to look to the other end, through which goods have to pass upon their way to the consumer. Manufacturers cannot avoid such guilt as there may have been in playing up to the insatiable demand for novelty of appearance, even at the cost of the sterling quality of the goods. The taste for two or three cheap articles at the price of a single good one has not been wholly of their making, and now that economy is incumbent upon everybody they would not be sorry to find the consumer realising that the cheapest thing to buy is commonly the very best that can be bought.

Comparative Values.—The cheapest possible article of any largely sold kind of goods is usually the one carrying the smallest loading of profit. The article that is made to squeeze into some arbitrary limit of price brings the lowest percentage to maker, wholesaler and retailer alike. All three exert themselves to the utmost to make at least the show of "exceptional value," but the result is seldom economically satisfying. More is taken out of the value-in-use than out of the profitable margins. To cite an instance from practice obtaining before the war, some particulars of the cost and selling prices of certain German-made hosiery may be given. It was possible in certain neighbourhoods to buy knitted undergarments at 1*s*. 11*d*. retail, or 7*d*. more than the price received by the manufacturer. The next quality sold at 2*s*. 11*d*., or 1*s* 5*d*. more than the prime cost. One garment cost 2*d*. more than the other and sold 1*s*. dearer. The disparity is pretty formidable, but it is a matter of practically universal experience that the difference was money well spent. The 1*s*. 6*d*. garment at 2*s*. 11*d*. was a more remunerative investment than the 1*s* 4*d*. garment at 1*s* 11*d*. In its turn the latter of the two was again less advantageous than some at a higher cost. The cheapest of all was the one selling most largely of any, for naturally its patrons were the first to want new clothing, but in grasping at the shadow of cheapness they lost its substance. Although the instance is taken from the past, precise parallels could be drawn from the present.

The Supply of Labour.—It may henceforth become more urgently desirable to recall women to the mills, and the National Register ought to be of service in ascertaining the whereabouts of competent married women. There is some reason to suppose that a number of ex-operatives are more willing to undertake home work than factory work, and it is to be suspected that not all of them have avowed their skill in spinning and weaving. The shortage of operatives is most felt of course where business is briskest. Rochdale, which has been renewing its old position in the flannel manufacture, has drawn upon the Belgian refugees, the Isle of Man and the West of England, for women-workers. Want of hands is felt severely even in Nottingham and Leicester, towns where the industrial conditions are far from unpleasant, and where labour is normally plentiful. Greater difficulty is caused by the withdrawal of skilled mechanics who are relied on to keep intricate machinery in running order, and their replacement seems to be an insoluble problem. It takes a considerable emergency to move any large number of textile workers from place to place, and even collapse of the local trade will not always drive them afield. However, a certain movement of the population has occurred in times past, as when numbers of Coventry weavers made their homes in Lancashire, and Norwich weavers in Yorkshire, towards a century ago.

Cotton Waste in India.—An interesting beginning in the transference of German business is being

made in Bombay with the aid of machinery now upon order in Lancashire. The German mills have been the chief destination for the cotton waste which for a year past has been accumulating upon Bombay spinners' hands. The price has fallen to a nominal amount, and the presence of large supplies of raw material lends attraction to what is not normally a highly remunerative business. Had German profits been high, there must have been more competition from Lancashire, for the main difficulty encountered by various manufacturers making the attempt has been to get any adequate return for their labour. It is apparently in blankets and heavy goods that a beginning is to be made in India, and in these the troubles and risks of the finishing process are less than in the lighter flannelettes.

Remedying Oil Stains.—Stains made by the dropping of lubricating oil upon textile materials are a prolific source of loss, and are difficult to avoid. The damage done is naturally greatest in the case of light-coloured goods, and it is aggravated commonly by dirt coming from the bearings of the machinery It has, however, been found that oil, itself colourless, is capable of giving rise to dark stains, which develop gradually upon exposure to light. The action is due to the oxidation of free hydro-carbons present in some oils and not present in others. To test the liability of oils to darken in sunlight is a matter of three or four months, and to hasten the process a lamp test has been devised by an American chemist. Mr. T. T. Gray employs a Cooper-Hewitt quartz lamp giving a light rich in the ultra-violet rays, and by exposing samples at six inches distance from the light useful indications are obtained in half an hour. The method is comparative: strips of cloth impregnated with oil of known quantity are tested against the unknown, and certain oils which do not darken in sunlight tests are found to take a yellow-brown cast under the lamp.

The Strengths of Fabrics.- In this country the testing of the tensile strength of fabrics is influenced by the requirements of the Government departments who happen to be the principal buyers of cloth made to standards of strength. For the rest, practice has been determined by the example of institutions like the Manchester Chamber of Commerce Testing House and the Bradford Conditioning House. In America the framing of specifications has been undertaken by a committee, primarily with a view to standardising tests for the now considerable quantities of cotton cloth used as a basis for pneumatic tyres. Important variations of result are obtained accordingly as the atmospheric humidity changes, and although the American Society for Testing Materials has provided for the preliminary drying of the specimens in an oven, it has not provided that the test of strength shall be conducted within a controlled atmosphere. It is required simply that the breaking-strain shall be read within thirty seconds of removal from the oven. In the particular case the difficulty of measuring the fabric "as it lies flat without tension upon a smooth surface" may be at its minimum, but the scrupulously exact measurement of fabrics at large might involve the fixing of a standard of tension. The specifications are not put forward as final, but are meant for amendment after one year's practical experience of them has been gained. The framers have been at some pains to insist that measurements shall be made on the average of a whole piece, the width and number of threads being determined by five tests at intervals. The enlarged scale of Government purchases may have done something to reconcile manufacturers to rigid tests other than those of length, width and weight, but it would be impossible to say that compliance with arbitrary and high-pitched standards of strength has been at all popular with manufacturers hitherto. The explanation is probably to be found in the selection of features for testing. At all events, in articles of dress it does not follow that the one which resists the highest tensile strain is *ipso facto* the strongest in wear, because wear does not consist entirely of the application of extreme pulls. For the regular purposes of commerce the sufficiency of the tensile strength can be determined by thumb tests The fabric is strained across the thumbs by steady pressure and the result is observed. In the case of cloth brought under iron regulations, or tyre fabrics intended to withstand an internal pressure which would burst some steam boilers, matters are on a different plane; and it would seem that we are to have more fabrics requiring to be made to absolute standards of tensile strength. The development of aerial navigation is adding to the number, and so long as standards are not made artificially difficult of attainment, little is to be said against their establishment.

GENERAL NOTES.

Awards to British Exhibitors at San Francisco.—The preliminary list of awards at the Panama-Pacific Exposition, San Francisco, has been received by Mr. W. A. M. Goode, who acted as Hon. Secretary of the British Committee which arranged for participation for exhibitors from this country. Despite the war and lack of Government support, British manufacturers are stated to have received more awards than any other foreign exhibiting nation. The Grand Prix has been granted to the following British firms: Messrs. Joseph Baker & Sons, Ltd. (bread-making machinery); Messrs. John S. Brown & Sons, Ltd., Belfast (linens): Mr. Bernard Moore, Stoke-on-Trent (pottery); the Gas Light and Coke Company, London; Messrs. Gibson & Sons, Ltd., Burslem (earthenware); and Messrs. Gordon's Dry Gin Company, London. The Medal of Honour has

been awarded to The Mersey Docks and Harbour Board, Liverpool; Lady Egerton (hand-made laces and embroideries); Messrs. R. H. and S. L. Plant, Longton (pottery); Messrs. Booths, Ltd., Tunstall (pottery); the Ashby Potters Guild, Woodville (pottery); Messrs. Birks, Rawlins & Co., Stoke-on-Trent (porcelain); the Ceramic Art Association, London (pottery); Messrs. The Tintometer, Ltd. (colour registering); and Messrs. Lips, Ltd. (safes and locks). The Gold Medal has been awarded to the Magnesite Syndicate, Ltd., London; the Vizianagaram Mining Company, Ltd., London; Messrs. William Livingston, Lurgan, Ireland (linens); Messrs. Ian Barry (Bergdahl walnut); the Stonehenge Woollen Industry, Lake, near Salisbury; the Fisherton de la Mere Embroidery Class, Wiltshire; Messrs. Worsnop & Co., Halifax (battery); Messrs. Riordan & Co, London (life-saving waistcoat); Messrs. Baker & Co., Fenton (pottery); Messrs. Myott, Son & Co., Cobridge (pottery); Messrs. William Adams & Co., Tunstall (pottery); Messrs. F. Fielding & Co., Stoke-on-Trent (earthenware); Messrs. A. J. Wilkinson, Burslem (earthenware); and Messrs. W. H. Goss, Stoke-on-Trent (porcelain). A Silver Medal has been awarded to the Loch Fyne Kintyre Lace Classes, Tarbert, Loch Fyne. A further list of awards is expected in the near future.

Far-Eastern Coffee Supply.—The Bureau of Agriculture of the Philippine Islands at Manila announces that a determined effort is to be made by the Government of the territory to rehabilitate the coffee production of the islands. The coffee supply of the Far East at present is not satisfactory, and there is a ready market at good prices in neighbouring countries for all the coffee the Philippines are likely to produce for some time. That the Philippines can produce excellent coffee is well known. At one time the export of coffee was one of the principal items in the list of products sold abroad, and Batangas Province, the centre of the industry, was one of the most prosperous provinces in the archipelago, the city of Yipa especially being known as an important coffee centre. About 1890, however, the coffee trees were attacked by various blights and rusts, and the industry was ruined in the course of a few years. The Philippine Government has been experimenting for some time with various varieties of coffee with a view of introducing a blight-resisting variety in this same province, and after several years of experiment it has found that the "robusta" variety is immune to the ravages of insect and other prevailing pests. The Bureau of Agriculture has prepared 3,500,000 plants in seed beds. It plans to set out trees covering 10,000 hectares (about 24,710 acres) in five years, with 2,000 coffee trees per hectare (about 810 trees to the acre). It is anticipated that at the end of that period Batangas Province will have at least 20,000,000 coffee trees in bloom. The trees are to be distributed free. They have been grown and experiments have been carried on under the supervision of experts from Java.

Japanese Knitting Yarns in Hong-Kong.—For the first time in the history of the trade, according to the American Consul-General at Hong-Kong, Japanese knitting yarns are cutting into the American trade in such yarns in Hong-Kong and in the China field generally. In the Yangtsze Valley the import of Japanese knitting yarns is understood to be increasing at a rapid rate. In Hong-Kong and South China the increase is not so rapid, and in some respects it is not at all certain that it will be permanent. However, the Chinese factory people have been buying some of the Japanese yarns, and are slow about taking delivery of American yarns heretofore ordered by them, giving rise to a rather well-founded suspicion that they are looking into the possibility of using the cheaper Japanese materials. It is likely that at best the trade in Hong-Kong and in China generally will be upset for some time to come. The Japanese are turning out very fair yarns made of American and Chinese cottons at c.5 to c.10 local currency per pound cheaper than American yarns of the same count. These yarns are not so good as American yarns, and the goods made from them are not as good as those manufactured from the American yarn, but the yarns and the goods make a very good appearance, and for the time being, at least, are securing increasing trade. The Japanese yarns now coming into the market are attractive in appearance and run well in the machines.

Potash in the Philippines.—It has been found that the ash of the seaweed collected on the shore of Manila Bay in Tondo yields 15 per cent. of potash. This discovery, according to a report by the Correspondent at Manila of the United States Department of Commerce, has aroused considerable interest, owing to the war-time scarcity of potash. No data exist to show the exact amount of seaweed available, but it is known in a general way that it is abundant. Explorations and further experimentation will be conducted by the Government.

Tobacco Crop of the Cavalla District.—Some details of the tobacco crop of the Cavalla district in 1914 are given by the British Vice-Consul at Cavalla, in a report which is included in a general report on the Salonica district, just issued by the Foreign Office. It appears that last year the crop was abundant, being estimated at about 16,000,000 kilogrammes for the districts of Cavalla, Sarishaban, Drama, Pravista, Buk, Serres, etc. Connoisseurs, however, consider that the 1914 crop leaves much to be desired as to quality, and they estimate that it contains about 60 per cent. of inferior tobacco. This tobacco will be manipulated during the course of 1915, and will not be ready for export before the end of the year. Leaf tobacco is the principal, indeed almost the only, article of export from the port of Cavalla.

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All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICE.

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PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

FOODSTUFFS.

By David Sommerville, B.A., M.Sc., M.D.,
Assistant Professor of Hygiene and Public Health, King's College, London.

Lecture II.—Delivered May 3rd, 1915.

Modern work on enzymes has produced the view that the activities of these substances—if special substances there be—are of the order of those of catalysts, *i.e.*, in the presence of such substances the rate of a particular chemical reaction is increased; but the reaction is not initiated. In many biological, as distinguished from purely chemical, reactions one is struck by the ease displayed in the mode of producing the result. In the animal body raw protein is smoothly and rapidly converted into amino-acids at body temperature; in the chemical laboratory the strongest acids at boiling temperature are needed to produce this result.

Since the days of Berzelius the subject of catalysis has been eagerly discussed, and the fact that catalysts are found at the end of the reaction unchanged, except in certain cases in which they are destroyed by subsidiary reactions, has been deemed sufficient to place them in a class apart.

Catalysts are definite chemical compounds: enzymes are not yet known to be such. Catalysts, in a large number of reactions at least, form intermediate compounds during the course of the reaction. That some form of intermediate reaction occurs between the enzyme and substrate is a view held by most.

In those biological reactions with which we are at the moment concerned, one or more of the interacting bodies is always colloidal, and all enzymes are regarded as colloids. This leads to a word concerning the colloidal state. Colloidal solutions possess peculiar physical properties inextricably bound up with the enormous surface presented by the particles. If a liquid be contained between two parallel plates and one of these be moved with a constant velocity in its own plane a certain force is

required which depends on the velocity, the surface and distance of the two plates, and on the temperature and nature of the liquid. The force required to move a plate of unit surface separated from another plate of the same size by a layer of liquid of unit thickness at unit velocity is known as the viscosity coefficient. Colloidal solutions may be divided into two classes if the increase of viscosity compared with that of the continuous phase (solvent) be made the basis of classification. One class presents a viscosity only slightly higher than that of water (metal and sulphide solutions). The other, the organic colloids (albumin, gelatin, etc.), presents a marked increase of viscosity. In those solutions presenting a low viscosity the disperse phase is present as solid particles; in those with high viscosity the disperse phase is liquid. Albumin solutions consist of a dilute solution of albumin, in which are dispersed globules of a more concentrated solution. Systems of solid particles of microscopic size distributed in a liquid are known as "suspensions"; those consisting of two liquid phases are known as "emulsions."

The particles in solution, if sufficiently small, are in constant motion oscillating round a central position, and also undergoing an irregular translatory motion. Svedberg showed that the amplitude of the motion of a particle is directly proportional to the period, and inversely proportional to the viscosity of the liquid. Perrin showed that this Brownian movement conformed to the principles of the kinetic theory, and that the particles could be treated as large molecules. The stability of the solution is intimately connected with the electric charge. The charge can be altered by the addition of electrolytes, and may fall to zero with suitable concentrations, in which last case the solutions precipitate. It has long been known that the speed of settling of such suspensions can be increased by the addition of electrolytes. In systems of two liquid phases it can be shown that very small liquid particles, approaching ultramicroscopic dimensions, possess a high degree of rigidity. Systems of two liquid phases possessing few and widely separated particles, differ in no important respect from systems containing rigid particles; but an important difference appears as the amount of disperse phase per unit volume increases. In the case of rigid spherical particles in contact, the disperse phase may reach a maximum of 74 per cent. of the total volume. If the disperse phase be liquid, the globules may not merely touch one another but become flattened at the points of contact, from which circumstance it is obvious that there is no limit to the ratio

$$\frac{\text{volume of disperse phase}}{\text{total volume}},$$

which ratio may approach unity.

The distinguishing feature of colloids is their enormous surface development. A variety of processes which affect surface energy occur at boundary surfaces between two phases, such as compressibility, change of solubility, electrical charge, etc.

When solids are immersed in fluids, the film at the interface behaves as if stretched; all free surfaces of liquids exhibit this property. Now if colloidal particles be suspended in a liquid containing in solution any substance which lowers the surface tension of the liquid it is clear that if this substance accumulates at interface of particle and liquid, the surface tension at this interface will be lowered. It has been concluded, from principles of thermodynamics, that increase of concentration at a surface will always occur when the potential of any form of energy at this surface can be lowered by the process. Such lowering may be thermal, chemical, electrical, mechanical (surface tension). This concentration at a surface is known as "adsorption."

Colloids take up by adsorption various other bodies, especially colloids, and the process is intensified if the interacting bodies have opposite electrical charges, lessened if similar charges.

The laws of formation of adsorption compounds are illustrated by reference to such phenomena as the following: (1) Physical partition in proportion to relative solubility as exemplified in the oft-quoted case of picric acid in water and ether. Picric acid is soluble in each of these liquids, but more soluble in ether than in water. Where constant quantities of picric acid, ether, and water are used a constant quantity of the picric acid, say four-fifths, is found in the ether, and the remainder, one-fifth, in the water. Double the picric acid, preserving the proportion of solvents as before, and the result is a solution of double the quantity of the acid in each of the solvents. (2) Strict chemical reaction as seen in the case of chlorine precipitated by silver. If to a solution of hydrochloric acid a solution of silver nitrate be added, sufficient to fix the whole of the chlorine, the whole of the chlorine falls, and the addition of further silver nitrate is without effect on the chlorine. (3) Adsorption between colloids. This is illustrated by the common case of filter paper

and various dyes. If filter paper be immersed in a dilute solution of dye, a portion of the latter adheres to the paper, but not the whole: here is a precipitate (chemical) and at the same time a partition of the dye (physical). Double the concentration of the dye and, unlike the chemical reaction, more dye is precipitated on the paper, and, unlike the physical, the quantity of dye adsorbed is not double but less; instead of two the factor is some root of two—mostly less than the square root. In other words, when the concentration is doubled the amount adsorbed is $2^{\frac{1}{n}}$, where n is greater than 1 and less than 2. Adsorption may be applied to any values of n less than infinity when it becomes purely chemical. When $n = 1$, physical partition is expressed. It is here to be noted that relatively more adsorption takes place in more dilute solutions.

Electrically-charged colloids and electrolytes can precipitate colloids carrying charges of the opposite sign. Organic colloids can be made positive or negative by addition of acid or alkali respectively. All these colloidal reactions appear to possess a physical and chemical aspect, in some cases one predominating, in other cases the other. Many reactions are obviously purely chemical. But certain colloids possess adsorptive affinities other than chemical, and this applies for the most part to enzymes.

Enzymes, as a rule, are destroyed by temperatures below 100° C. But some enzymes can withstand the temperature of boiling water. Heat is not, therefore, a test of enzymes. The catalytic properties are, in the end, the only certain means of identifying enzymes.

The form in which the substrate is presented to the enzyme is of considerable importance. This is illustrated by the following *in vitro* digestion which I carried out some time ago. In milk dried by the Merrill Soule process, the particles of caseinogen in the reconstituted fluid differ in character from those in raw milk. Adsorption between enzyme and substrate appears in this instance to be more complete in the dried variety; at any rate, digestion proceeds more rapidly.

Peptic Digestion.—Five grammes of powdered milk were rubbed up with 42·5 c.c. water and placed in a digesting jar. In a similar jar were placed 47·5 grammes fresh milk containing 3·4 per cent. of fat. To the contents of each jar were added 0·1 gramme HCl and 0·05 gramme pepsin in dry powder. The jars were placed in a 37° C. incubator for periods of two and four hours. The contents at the termination of these periods were thrown on fine hard and weighed filters, and the residues carefully dried on the filters at a temperature below the melting-point of butter fat. A series of five digestions gave a mean excess in the weight of the dry residue (proteins and fat) on the raw milk filter over that on the powdered milk filter of 0·095 gramme. On extracting the residues on the filters with ether, and drying the protein residues, the weight of the latter derived from raw milk was still greater than that from the powdered milk. The excess of protein residue in the raw milk sample was further greater by 0·05 gramme in the case of the two hours digestion than in that of the four hours digestion. The ethereal extract when dried (fat) was greater in the case of raw milk than in that of the powdered.

Action of Rennin on the above Solutions.—To 100 c.c. of each of the solutions 1·5 gramme of an active preparation of rennin were added and the mixtures set aside at 26° C. In thirty minutes a firm clot had formed in the raw milk solution, whereas in the solution of powdered material no clot appeared, but instead a granular precipitate. At the end of an hour the raw milk clot was quite dense, whilst no clot existed in the solution of powder.

Tryptic Digestion.—To the same quantities of raw milk and solution of powder as used in the peptic digestion were added 0·1 gramme Na_2CO_3 and 0·05 gramme powdered trypsin, and digestions were carried out at 37° C. for two, four, and eighteen hours. In a series of thirty digestions the protein residues were all greater in the case of fresh milk than in that of the powder. These differences ranged from 0·05 gramme to 0·4 gramme, with a mean of 0·148 gramme in the four hours digestions. As in the peptic digestions the ethereal extract of the residues when evaporated left a larger amount of fat in the case of raw milk and more proportionately than in the peptic digestions.

The fat in the powder solution is no longer in emulsion, but is in a granular condition. The rate of protein hydrolysis, both peptic and tryptic, is greater in the solution of powder than in the natural variety of milk.

The mechanical and other physical conditions pervading the mixture of enzyme and substrate are, in certain cases, factors of the first magnitude in enzymic hydrolysis, and are doubtless important also in those activities which result in oxidation and reduction. The following piece of work, which I executed in 1911, on the hydrolysis of castor oil, illustrates the first

portion of this statement. I quote the account of the work as it then stood:—

"In 1902 Connstein, Hoyer and Wartenberg described a series of experiments carried out at Charlottenburg, by which it was sought to determine the *modus operandi* of fat-splitting in vegetable oils by an emulsion of the castor bean. Hoyer continued the work in 1904 and made an attempt to isolate the enzyme. He used as activators of his enzyme acetic acid and sulphate of manganese.

"In 1906 Nicloux, after several years' work on the fat splitting properties of the castor-oil bean, commenced some years before that of the three authors mentioned, came to the conclusion that the cytoplasm of the seed contains the active agent, and that this substance acts in every way as an enzyme, but is not an enzyme.

"It is customary to-day to assume that hydrolysis is preceded by a combination of the hydrolyte with the enzyme—Emil Fischer's lock and key relationship between bodies of asymmetric configuration.

"It is known that esters of the lower terms are more difficult to hydrolyse than those of the higher; in other words those esters most readily soluble in water are most difficult of hydrolysis. Is this due to a previous hydrolysis of some portion of the hydrolyte, or to a previous hydrolysis of some portion of the so-called enzyme?

"In reviewing the experiments of Nicloux and Hoyer I worked with the castor-oil bean acting on its own oil and on cottonseed oil. The results were equally good in the two cases, so that no specificity can be claimed for the enzyme of the castor seed towards its own oil.

"I prepared an emulsion of ground castor beans and incubated it at 25° C. until hydrolysis of the oil had been definitely established. A measured quantity of the incubated emulsion was then added to a mixture of measured quantities of oil (castor or cotton, as the case might be) and water. The mixture was shaken for a few minutes at intervals of a quarter of an hour for some hours and then left. The percentage of free fatty acids formed in three days at laboratory temperature ranged from 80 to 85.

"On repeating Hoyer's experiments, in which he used acetic acid and manganese sulphate, I did not find that the addition of these bodies produced any increase in the amount of free fatty acids liberated.

"I noticed early in the experiments that if hydrolysis (fatty acid liberation) were not properly established in the emulsion (enzyme) the yield of free fatty acid was correspondingly low. Success in the experiment largely depends on the intimate mixture of oil and enzyme. The preparation of the enzyme demands the use of a quantity of water from which the enzyme can later be separated. This water when applied to oil is wholly inactive. Further, the active enzyme, when mixed with two or three volumes of water, alcohol, or acetone, rapidly loses its activity; whereas when mixed with two or three volumes of ether or benzene no loss of activity occurs. On the lock and key hypothesis the meaning of these contrasts is difficult to seek.

"Nicloux described his enzyme as refractory to heat when protected by oil; my emulsion, when heated to 60° C., rapidly loses its activity. But when the bean from which the emulsion is prepared is heated to 100° C. for twenty-four hours in a dry bath little or none of its activity is lost.

"Pancreatic lipase has been separated into two portions by ordinary filtration, and it has been found that the activity of the filtrate is not diminished by boiling, whereas heating the residue destroys its potential energy. I have not been able to effect any such separation in the castor bean enzyme.

"That the activity is related to nitrogen-containing matter can be demonstrated; but whether the nitrogen is active or not it is impossible to say. The total organic nitrogen of my active emulsions, as estimated by Kjeldahl's method, always amounted to at least 0·2 per cent.

"Cotton oil and castor oil, when carefully neutralised and freed from proteins, fails to undergo hydrolysis. If to this oil an enzymic emulsion, in which hydrolysis of fat has not yet commenced, be added, nothing results. But let hydrolysis be established in the emulsion, and hydrolysis proceeds in the added oil, irrespective of whether this oil be neutral or contain within wide limits (25 per cent.) free fatty acids.

"Perhaps the most striking of all these features is the failure of the prolonged heating at 100° C.—a temperature which kills practically all proteins—to interfere with the activities of the bean. Is it that in the case of the dry bean, when heated, hydrolysis fails to commence, whereas in the mixture of enzymes and water hydrolysis rapidly exhausts itself?"

Since this was written I have not met with any experimental work which has thrown light on the problems raised. Although fats are simple chemical compounds compared with proteins, and simple also compared with some carbohydrates, there are many problems connected with their metabolism of which we know nothing accurately.

Since Croft Hill, in 1898, showed for the first time, through the action of maltase on glucose, that a hydrolytic enzyme under certain conditions can become a synthetic enzyme, the impression has been steadily growing that the action of all enzymes is reversible, given the necessary conditions. Enzymic activity takes place in systems of at least two components; the enzyme phase contains less water than the solution of substrate; accordingly, if the substances to be synthesised are more soluble in the enzyme phase than in water, partition will favour greater concentration in this phase than in water, and the enzyme phase being poor in water synthesis will be still the more accelerated.

The conditions may be such that only a very small proportion of synthesis is effected, but this small amount of substance, as in the case of the synthesis of starch, may be precipitated in an insoluble form and thrown out of action as quickly as it is produced, so that in time a large accumulation may appear. Hill regards the storage of starch in plants and glycogen in animals as produced in this manner.

Pancreatic lipase hydrolyses fats and also synthesises them. Ethyl butyrate is readily formed from ethyl alcohol and butyric acid. Monobutyrin, a butyric ester of glycerol, and mono- and tri-olein have been prepared.

The value of this reversibility of the action of lipase is obvious in connection with the digestion and absorption of fat in the cells of the intestine; here the fat as it is synthesised is thrown out of the reacting system on account of its insolubility, and passed over to the side of the tissues.

It is probable that carbohydrates and proteins are synthesised by the enzymes that hydrolyse them and from the self-same products of hydrolysis.

Whether adsorption or the union between enzyme and substrate is always specific we do not know. In some cases the evidence is satisfactory that such specificity exists; in other cases not.

During the absorption of oxygen by plants various substances are produced which can effect oxidations not brought about by oxygen alone, such as the bluing of guaiacum and the conversion of hydroquinone into quinone. These substances are characterised by great instability. They are destroyed by heat, mineral acids, and various poisons. It is claimed that they act catalytically, and are of the nature of enzymes. Bertrand has given them the name "oxidase"; and Bourquelot has classed them with ferments because of the following characteristics common to enzymes: power to effect the transformation of an indefinite amount of material by means of an infinitesimal quantity of ferment; powers of oxidation subject to influence of temperature, increasing with a rise of temperature to 42°–45°, falling off with a further rise to 60°–70°, and being destroyed at 100°; insolubility in alcohol; solubility in water even after desiccation and precipitation by alcohol; adsorption by precipitates after the manner of colloids.

That H_2O_2 is formed during the oxidation of oxidisable substances was known to Schoenbein; and many observations on the production of H_2O_2 as the result of oxidation by molecular oxygen in the presence of water were made by Traube. This observer held that in autoxidation the oxygen molecule as a whole combines with the oxidisable substance or with the hydrogen of water under the influence of the oxidisable substance to form a peroxide—thus, when hydrogen burns in the air, H_2O_2 is the primary product of oxidation—and that the resulting water is due to the reduction of the peroxide by hydrogen—

$$H_2 + O_2 = H_2O_2$$
$$H_2O_2 + H_2 = 2H_2O.$$

He held that water actively participates in all autoxidations, and that it is necessary even in such cases as the oxidation of carbonic oxide—

$$CO + \begin{matrix} HO\ H \\ HO\ H \end{matrix} + O_2 = H_2CO_3 + H_2O_2$$
$$CO + H_2O_2 = H_2CO_3$$
$$2H_2CO_3 \quad = 2CO_2 + 2H_2O.$$

Traube explained the carrying of oxygen as due to the oxidation of the second oxidisable substance by the H_2O_2 resulting from the oxidation of the carrier in the presence of H_2O. He held, contrary to the views of Hoppe-Seyler, that it is not the oxygen molecule that is decomposed in autoxidations, but the molecule of H_2O with liberation of atomic hydrogen, which last combines with molecular oxygen to form H_2O_2.

That the (OH) group of water plays many an important part in animal catabolism there can be no doubt. Even oxidation of saturated compounds in the laboratory consists for the most part in the replacement of H by OH. In the case of the hydrocarbon CH_4, Bone has shown that in both slow and explosive combustion hydroxylated molecules appear prior to the final products of combustion. He has identified formaldehyde and steam. He holds that formaldehyde at high temperature splits into carbonic oxide and hydrogen, which ultimately become CO_2 and H_2O—

$$CH_4 \rightarrow CH_3.OH \rightarrow CH_2(OH)_2 \rightarrow COH_2$$
$$\rightarrow CO + H_2 \rightarrow H_2O + CO_2.$$

Many biochemical oxidations involving the formation of similar hydroxylated intermediate compounds occur.

Those compounds which are catabolised in the body, viz., proteins, carbohydrates and fats, are quite resistant to the action of oxygen under ordinary conditions. In the presence of oxidases their carbon passes easily into CO_2. It was thought at first that H_2O_2 was the essential oxidase, but later it was recognised that a large number of peroxides might occur as intermediate stages in autoxidation. Indigo alone is unaffected by oxygen. Associated with benzaldehyde one half of the oxygen secured

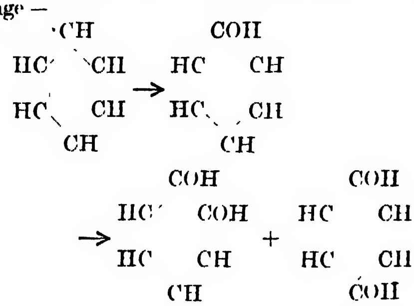
for the autoxidation of the aldehyde is used in oxidising the indigo. Villiger and Bayer have demonstrated the mechanism of this reaction: Benzaldehyde unites with O to form benzoyl-hydrogen peroxide, $C_6H_5.CO.O.OH$. In the absence of other oxidisable material this body interacts with a second molecule of benzaldehyde to form two molecules of benzoic acid—

$$C_6H_5.CO.O.OH + C_6H_5.COH = 2C_6H_5.COOH.$$

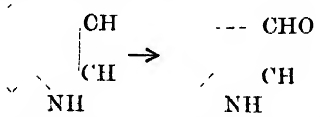
In the presence of indigo only one molecule of benzoic acid is formed, whilst the indigo is oxidised.

As Dakin points out, if the hypothesis of superoxide be correct, one would expect a certain similarity between the oxidations effected in the body and those brought about by the simplest peroxide, viz., H_2O_2; and such similarity exists.

Benzene is oxidised in the body to phenol, catechol and quinol. H_2O_2 produces the same change—



Indol is oxidised in the body to indoxyl. H_2O_2 produces the same change—



Grape sugar may be oxidised to glycuronic acid. H_2O_2, and H_2O_2 only, produces the same change *in vitro*—

$$\begin{array}{lcl} CH_2OH & & COOH \\ | & & | \\ (CHOH)_4 & \rightarrow & (CHOH)_4 \\ | & & | \\ COH & & COH \end{array}$$

As shown by Knoop, saturated fatty acids in the body undergo oxidation in the β position, *e.g.*, butyric acid yields acetoacetic acid. H_2O_2 alone produces the same result *in vitro*—

$$\begin{array}{lcl} CH_3 & & CH_3 \\ | & & | \\ CH_2 & \rightarrow & CO \\ | & & | \\ CH_2 & & CH_2 \\ | & & | \\ COOH & & COOH \end{array}$$

Hydroxy acids are oxidised to ketonic acids in the body and by H_2O_2—

$$\begin{array}{lcl} CH_3 & & CH_3 \\ | & & | \\ CHOH & & CO \\ | & & | \\ CH_2 & \rightarrow & CH_2 \\ | & & | \\ COOH & & COOH \\ \beta\text{-hydroxy butyric} & & \text{aceto-acetic acid} \end{array}$$

Amino- acids and ketonic acids are oxidi to lower fatty acids with separation of CO_2 a NH_3 or H_2O. Glycerol may be oxidised by body and H_2O_2 into glyceric aldehyde—

$$\begin{array}{lcl} CH_2OH & & CH_2OH \\ | & & | \\ CHOH & \rightarrow & CHOH \\ & & | \\ CH_2OH & & COH \end{array}$$

A host of other biochemical reactions, such as the oxidation of acids, aldehydes, and alcohols, may be effected in the test tube by H_2O_2.

Reference must be made to the saturated and unsaturated acids. In the body these two types appear to be oxidised equally easily. *In vitro* the saturated acids are infinitely more difficult of oxidation than the unsaturated. Again, the facility with which H_2O_2 performs the oxidation approximates that of the body. On the other hand, oxalic acid, whilst readily oxidised *in vitro*, is most difficult of oxidation in the body. In like manner it is scarcely attacked by H_2O_2.

Notwithstanding the analogies quoted, as above mentioned, H_2O_2 is not the peroxide present in living cells. Any such conception is at once put out of court by the fact that the widely distributed enzyme catalase at once decomposes it.

The path of oxidation is not always continuous; reductions not infrequently occur. And considering the manner of enzymic action, especially the property of reversibility, such activities are to be expected. A striking example of reduction, coupled with oxidation, is exemplified in the so-called reaction of Cannizzaro. When aldehydes are treated with alkalies two molecules of aldehyde undergo transformation in such a manner that one is reduced to the corresponding alcohol, whilst the other passes over into the acid—

$$2R.COH + H_2O = R.CH_2OH + R.COOH.$$

Parnas and Battelli and Stern showed that this reaction takes place in the tissues.

These processes of oxidation that are constantly taking place in all living tissues are even more important than those of hydrolysis,

inasmuch as through them heat and other forms of energy are produced.

Schmiedeberg, and after him Abelous, perfused fresh liver tissue with oxygenated blood containing salicylaldehyde and recovered salicylic acid. The solubility of this aldehydase was studied by Jacoby, who found that 60 per cent. saturation $(NH_4)_2SO_4$ threw down the enzyme. He dissolved it in water, reprecipitated it with alcohol, and found that on again dissolving it, no reduction had occurred in its oxidising properties.

Laccase, tyrosinase, oenoxidase, maloxidase, olease, purpurase, and other oxidases have been carefully studied by a number of able observers.

Tyrosinase, whilst not so widely distributed in nature perhaps as laccase, has been found in a large number of plants and animals, also in bacteria. Gessard found that the melanotic pigment in certain tumours of the horse was produced in the same way as the ink of the cuttle-fish, viz., by the interaction of a chromogen and an oxidising ferment. He was able to obtain tyrosine from such tumours, with which he produced the colour changes characteristic of tyrosinase. He concluded that tyrosine is the chromogen whose oxidation by tyrosinase gives rise to the pigment in melanotic tumours. Gessard believes that the same reaction causes the colour of the negro, the ink of the cuttle-fish, and the black pigment of mushrooms.

Bertrand has studied the action of tyrosinase on various bodies analogous in structure to tyrosine. He observed no colouration with glycocoll, alanine, phenylacetic acid, phenylpropionic acid, phenylamino acetic acid, phenylmethylamine, and phenylalanine. With compounds containing phenolic hydroxyl characteristic colours were observed. He concludes that only substances containing phenolic hydroxyl are oxidised by tyrosinase.

Tyrosinase contained in the skins of animals only acts on tyrosine in the presence of small amounts of iron.

It may be incidentally noted here that I have found in the fæces of individuals exhibiting melanotic pigment abnormally large quantities of tyrosine or other hydroxy-phenyl amino-acid.

Another class of enzymes concerned in the oxidations continuously occurring in plants and animals is that of the peroxidases. Bourquelot named them the indirect oxidising ferments. Bach and Chodat regard their action as specific in that in the absence of H_2O_2 or similar peroxide they have no oxidising power. They find that they not only activate hydrogen peroxide and the peroxides resulting from the slow oxidation of such bodies as alcohol, ether, and the essential oils, but also that they increase the oxidising powers of the oxidases.

The catalases are the most widely distributed of all the oxidising enzymes, for every tissue which gives the peroxide reaction with guaiacum and H_2O_2 can also decompose the peroxide, whilst certain tissues able to effect the latter reaction cannot effect the former. Their action is also regarded as specific. They all possess the common property of being able to decompose H_2O_2 into water and molecular oxygen, and the negative property of being unable to activate the oxygen of the peroxide toward oxidisable substances.

When it became known that different proteins, fats, and carbohydrates are not physiologically equivalent—that certain chemical groups execute special functions in the animal organism —it was seen that progress could not be made apart from the study of such groups as were met with in the intermediate products of metabolism. The study of intermediate products in the oxidation of fatty acids has led to much valuable information in this direction. The most easily digested of all fats are the fats of milk. They are composed of fatty acids containing 4, 6, 8, 10, 12, 14, 16, and 18 carbon atoms. They all undergo complete oxidation in the body with formation of CO_2 and H_2O. The 4-carbon acid (butyric) is the lowest that occurs in the body in the form of fat. Propionic, acetic, and formic acids occur in the organism, but not in the form of fat. Fats of 16 and 18 carbon atoms predominate. The oxidation of a molecule of palmitin, stearin, or olein necessitates the formation of various intermediate bodies. The ease with which such intermediate substances undergo oxidation led to the introduction of a refractory radical, phenyl, by Knoop. This observer worked with the phenyl derivatives of acetic and the next three acids. He found that phenylacetic acid is not oxidised in the animal body, but combines with glycocoll to form phenaceturic acid. On the other hand, β-phenyl propionic is oxidised to benzoic, which unites with glycocoll and passes out of the organism as hippuric acid. On considering these two reactions Knoop concluded that the oxidation of the 3-carbon atom side-chain of phenyl propionic acid did not occur with formation of a 2-carbon side chain—phenyl acetic otherwise phenaceturic acid would have appeared, as above. Two-carbon atoms appeared to have been removed at once. Further work by Knoop and confirmatory work by Dakin proved this to be true.

On his experiments Knoop conceived his hypothesis of β-oxidation, viz., that the H attached to the β-carbon atom is attacked for oxidation, and that consequently the carbon chains are reduced by the loss of two or a multiple of two carbon atoms at a time. It seemed likely that β-hydroxybutyric acid and acetoacetic acid excreted by diabetics were intermediate products of the β-oxidation of butyric or higher fatty acids. Experimental work on dogs proved that an increased excretion of β-hydroxybutyric acid and acetoacetic acid followed administration of salts of butyric acid-

$$CH_3.CH_2.CH_2.COOH \rightarrow CH_3.CHOH.CH_2.COOH \rightarrow CH_3.CO.CH_2.COOH.$$

Knoop's theory met with much opposition on the ground that such oxidation in the β position was unknown in pure chemistry. Dakin showed that such a reaction *in vitro* was not only possible, but he produced it. He neutralised butyric acid and digested it at 37° with H_2O_2. He obtained acetoacetic acid, acetone, lower fatty acids and CO_2. When he increased the temperature the acetoacetic acid was converted into acetone with loss of CO_2, according to the general reaction of β-ketonic acids. It was not possible to detect β-hydroxybutyric acid.

The reaction was extended to higher fatty acids, which all gave the corresponding ketone containing one less carbon atom. Later Embden showed that acetone was derived from acetoacetic acid, and that in the normal fatty acid series from propionic to decoic acetoacetic acid formation only occurred in those acids possessing an even number of carbon atoms. Although β-hydroxybutyric acid could not be detected it is not likely that a single reaction could shorten the carbon chain by two atoms. Embden showed that both butyric and β-hydroxybutyric acids when perfused through a surviving liver gave origin to acetoacetic acid.

Of acids with branched chains the oxidation of three containing the isopropyl group—

$$\begin{matrix} CH_3 \\ CH_3 \end{matrix} \rangle CH—$$

viz., isobutyric, isovaleric and isocaproic, have been carefully studied, with the result that it is found that they tend to part with their side chains and then undergo oxidation on similar lines to those of the straight-chain acids.

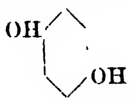
Embden, in studying the catabolism of amino-acids by his liver-perfusion method, found that the behaviour of these acids is similar to that of the derived fatty acid containing one less carbon atom. Leucine gives acetoacetic acid in the same manner as does isovaleric acid, so that it is reasonable to suppose that the second appears as an oxidation product of the first—

$$\begin{matrix} CH_3 \\ CH_3 \end{matrix} \rangle CH.CH_2CHNH_2.COOH + O_2 = \begin{matrix} CH_3 \\ CH_3 \end{matrix} \rangle CH.CH_2.COOH + NH_3 + CO_2.$$

Knoop has studied the catabolism of γ-phenyl α-aminobutyric acid and shown that α-ketonic acids form at once stages in the oxidation and synthesis of amino-acids.

Substances containing the benzene nucleus do not readily undergo oxidation in the animal organism. Exceptions to this rule are found in phenylalanine, tyrosine and tryptophane.

Considerable attention has been paid to the condition known as alcaptonuria, in which the body fails to oxidise phenylalanine and tyrosine, converting them into homogentisic acid—



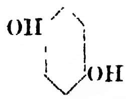
$CH_2.COOH$ (1.4 dioxybenzene acetic acid)

which appears in the urine. This body has been definitely proved to be derived from phenylalanine and tyrosine.

The relationship of the three bodies is seen in their structural formulæ—

$CH_2.CHNH_2.COOH$, phenylalanine.

$CH_2.CHNH_2.COOH$, tyrosine.



$CH_2.COOH$, homogentisic acid.

It was assumed that homogentisic acid was a normal intermediate product of the oxidation of phenylalanine and tyrosine and that the alcaptonuric failed finally to oxidise it through acetoacetic acid to CO_2 and H_2O.

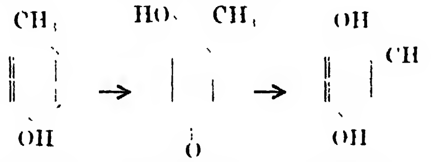
To this view Dakin objects, relying on the analogy from experiments by Neubauer and Knoop on the oxidation of phenyl derivatives of α-aminoacetic and α-aminobutyric acids in which α-ketonic acids are first produced.

The corresponding α-ketonic acids derivable from phenylalanine and tyrosine are $C_6H_5.CH_2.$

CO.COOH (phenylpyruvic acid) and $C_6H_4OH.CH_2.CO.COOH$ (*p*-hydroxyphenylpyruvic acid). Both of these acids are easily oxidised in the body with breaking up of the benzene nucleus; both produce homogentisic acid when administered to an alcaptonuric patient; and both readily yield acetoacetic acid when perfused through a surviving liver. So far they resemble phenylalanine and tyrosine, from which they may be derived. Moreover, Embden has demonstrated the synthesis of the amino- acids from these ketonic acids. With regard to the next step, Dakin does not believe that the ketonic acids are oxidised to saturated acids with one carbon atom less because the phenylacetic acid and *p*-hydroxyphenylacetic acid which would be formed both resist further oxidation in the body. These do not yield homogentisic acid when administered to an alcaptonuric patient, nor acetoacetic acid when perfused through a surviving liver, but when fed to animals are secreted unoxidised in conjunction with glycocoll.

It appears, then, that the next step involves the opening of the benzene ring, and Dakin quotes the analogy of Jaffe's observation, viz., that muconic acid may be isolated from the urine of dogs fed on benzene. Dakin and Wakeman think that the molecule of acetoacetic acid is formed at the expense of two carbon atoms of the nucleus and two of the side chain.

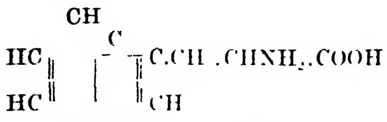
From the fact that homogentisic acid has its two OH groups on either side of the position of the OH in tyrosine it seems necessary to assume that the hydroxylation of the nucleus is effected by some molecular rearrangement involving a change in the relative positions of the OH group and side chain in tyrosine, and Dakin finds analogies for this kind of change in the rearrangement within the molecule of *p*-cresol undergoing oxidation to methylhydroquinone—



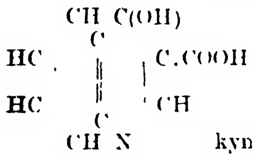
p-cresol tolu-quinol methyl-hydroquinone.

The oxidation of tryptophane, indole *a*-aminopropionic acid, in the normal human organism is apparently complete. Ellinger fed tryptophane to dogs, and found an increase of kynurenic acid in the urine. He was able to produce the same substance in rabbits. The conversion of tryptophane into kynurenic acid requires the entrance of an additional carbon atom into the indole ring with formation of a quinoline nucleus. This type of reaction has been accomplished *in vitro*. Ellinger obtained *β*-chlorquinoline and indole aldehyde by acting on indole with potash and chloroform.

The oxidation proceeds most likely by the formation of indylpyruvic acid as a first step, the opening of the pyrrole ring and the formation of the quinoline nucleus by incorporation of the *β*-carbon atom of the side chain and oxidation of the CO.COOH to COOH—



tryptophane.



kynurenic acid.

—C C.CH₂CHNH₂ COOH —C ⟶ —C.CO.CH₂ CO COOH	Analogy of conversion of side chain of phenylalanine into phenylpyruvic acid.

With the possible exception of pentoses the carbohydrates of the foodstuffs yield glucose in digestion, and as glucose are assimilated and catabolised. Glucose is for the most part stored as glycogen in the liver and muscles, but on utilisation is once more changed into glucose. The oxidation of carbohydrates is then the oxidation of glucose. Schmiedeberg and others long since showed that when camphor was injected into the body it was excreted in the urine in combination with glycuronic acid. Paul Mayer showed that rabbits starved until their store of glycogen was nearly all used, produced little or no glycuronic acid on administration of camphor; but on subcutaneous injection of camphor and glucose the excretion of glycuronic acid appeared as usual. Jolles has oxidised glucose in neutral solution with dilute H_2O_2, so as to obtain glycuronic acid. Bromine water readily oxidises glycuronic acid to saccharic acid, and this in turn is readily oxidised to tartaric and oxalic acids.

That glycuronic acid is derived from glucose appears certain, but the catabolism of glucose through the form of saccharic acid is doubtful. It is known that lactic acid may give rise to glycogen, and when given to a diabetic animal to glucose. It is much more likely that lactic

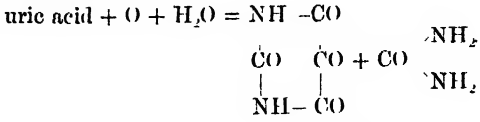
acid is an important stage in the oxidation of glucose. There is no evidence to show that saccharic acid has ever been found in any animal tissue or excretion.

Since Salomon discovered, thirty-five years ago, that purine bases are to be found in the nucleins which exist in the nuclei of cells, much work has been done to explain the chemistry of these nuclear constituents.

Nucleoprotein yields nuclein and protein. Nuclein yields nucleic acid and protein. Nucleic acid yields carbohydrates (pentoses, hexoses, etc.), phosphoric acid and bases.

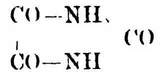
The four bodies, hypoxanthine, xanthine, adenine, and guanine, are known as the purine bases, and are closely related, chemically and biologically, to the important metabolic end-product uric acid. Emil Fischer's work threw much light on the whole group of purines and

nitric acid or chlorine, alloxan and urea are produced—



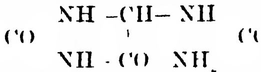
alloxan.

The oxidation of alloxan produces parabanic acid—

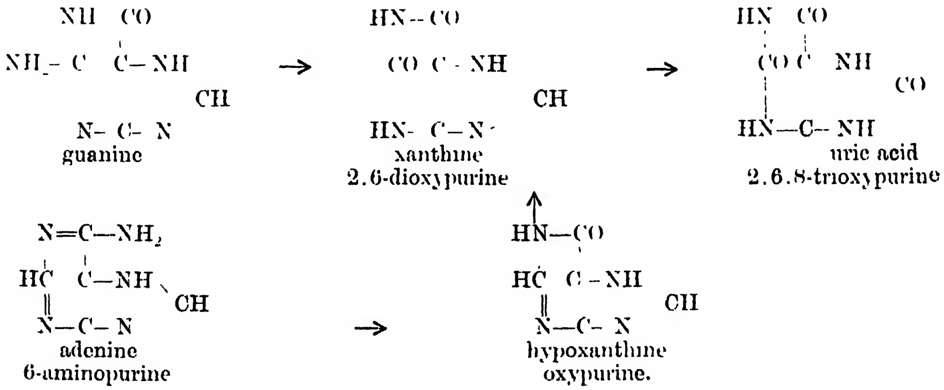


which decomposes in boiling water into urea and oxalic acid.

Uric acid can also be oxidised into allantoine—

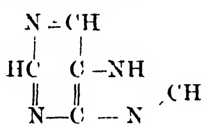


The relations of the purine bases to uric acid are seen in their structural formulæ—

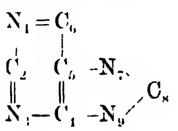


guanine; xanthine 2.6-dioxypurine; uric acid 2.6.8-trioxypurine; adenine 6-aminopurine; hypoxanthine oxypurine.

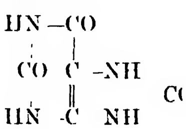
their derivatives. He obtained purine, a strong base readily soluble in water —



and numbered the ring thus—



Uric acid—



is 2.6.8-trioxypurine.

This formula is in conformity with definite reactions; uric acid, heated with HI and fuming HCl in a sealed tube, gives glycocoll, carbon dioxide and ammonia. Oxidised with

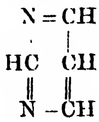
Three bodies closely related to the purines are

Caffeine 1.3.7-trimethyl - 2.6-dioxypurine;

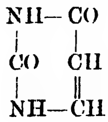
Theobromine 3.7-dimethyl - 2.6-dioxypurine:

And Theophylline 1.3-dimethyl 2.6-dioxy-purine.

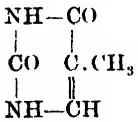
Three remaining bodies related to this group of cleavage products of nucleic acid have a pyrimidine ring instead of a purine ring —



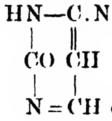
pyrimidine,



uracyl, 2.6-dioxypyrimidine,

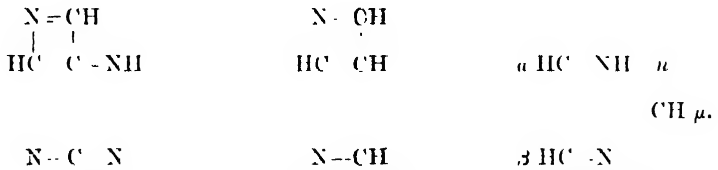


thymine, 5-methyl—2.6-dioxy-pyrimidine,



cytosine 6.amino - 2-oxypyrimidine.

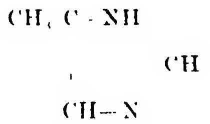
Burian tried to show how the purine bases are held in the nucleic acid molecules. He regarded them as primary cleavage products, as they were readily separated off by boiling water. The purines may be considered as a condensed nucleus formed of a pyrimidine and an imidazole ring—



purine pyrimidine imidazole

Several definite reactions support this view.

Knoop and Windaus have shown that if grape sugar be treated in the cold with ammoniacal zinc hydroxide an oxygen-free base, methyl imidazole—



is produced in quantity.

This is a most important link between the carbohydrates and the purine bases. It is possible that analogous reactions occur in plants. No evidence exists as yet to warrant the view that like changes take place in animal tissues.

Horbaczewski showed that the ingestion of nucleins increases uric acid in the urine, whilst food free from nuclein has no such effect. He also allowed spleen pulp, which contains no purine bases, to putrefy and separated xanthine and hypoxanthine. By shaking the putrefied pulp in air, he was able to obtain uric acid from oxidation of the bases.

Spitzer passed air through aqueous extracts of spleen tissue at 40°, excluding putrefaction, and obtained uric acid. He noticed that the quantity of purine bases decreased as the quantity of uric acid increased. Further purine bases added to the digest were converted into uric acid. He thus established the presence of the xanthine oxidases which convert purine bases into uric acid.

Schittenhelm found that in cattle the spleen, lungs, liver, intestine and kidney, can convert purine bases into uric acid in the presence of a constant supply of oxygen. He found that adenine was completely transformed thus—

adenine $\rightarrow$ hypoxanthine $\rightarrow$ xanthine $\rightarrow$ uric acid.

He further discovered that kidney, liver, and muscle extracts possess the power of destroying the newly-formed uric acid, and established the presence in the kidney of a uricolytic enzyme.

We may take it then that nucleic acid can be broken up by nuclease, an enzyme found in all tissues, that the purine bases are converted by enzymes into uric acid, and that uric acid can be destroyed by a third variety of enzyme.

Whilst purine bodies can be derived from ingested nucleins, this cannot be the only source, since purines are found in the urine during starvation and on a purine-free diet. A constant production of purine exists possibly through the destruction of cell nuclei. Uric acid and purines from this source are termed endogenous, in contradistinction to exogenous derived from nuclein-containing food. Burian and Schur determined that the endogenous uric acid elimination did not vary from day to day in the same individual, but was a constant factor of his metabolism.

A purine-free diet is found in such articles of food as milk, eggs, bread, potatoes, fats, and sugars, as none of these contain nucleins, and hence can form no exogenous purines. Burian found that on such a diet the uric acid elimination was quite independent of the quantity of protein ingested. Rockwood afterwards showed that the elimination of endogenous uric acid was independent of the calorific value of the diet. In Chittenden's experiments, spread over a period of a year and nine months, the low protein diet and moderate intake of food did not influence the output of uric acid.

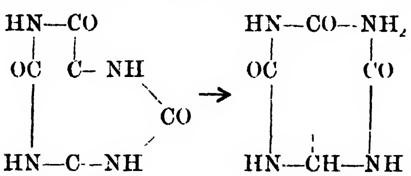
It is a remarkable fact that the liver has the power of oxidising uric acid, but not purine bases; hence the behaviour of exogenous purines must be the same as if they arose from the general metabolism.

Ingestion of the pyrimidine bases has failed to yield purines. It had been found that exercise

had no effect on the purine excretion in the urine of twenty-four hours in man. Burian finds, however, a large increase in the purine elimination for an hour or two after severe muscular exercise, and that this is followed by a compensatory reduction in the output during subsequent hours. He concludes that the most general source of endogenous purines is a constant production of hypoxanthine in muscle. Beebe has shown that endogenous purine metabolism is unchanged by the ingestion of alcohol, but that when alcohol was accompanied by nuclein-containing food the output of uric acid rose distinctly. In gout the oxygen absorption and carbondioxide elimination is the same as in health. Indeed, the general metabolism, exclusive of the purine factor, is the same as in health. In the light of modern research Garrod's view of gout, formulated about the middle of last century, appears as reasonable as any that has since been put forward, viz., that gout is due to an excess of urates in the blood. Minkowski regards gout as due to an abnormal metabolism in the nuclei of cells. But in leuchæmia, with a great increase in nuclei and large destruction of nucleoprotein with an enormous elimination of uric acid, there is no gout. Von Noorden suggests that gouty patients be tested for their tolerance for purines as diabetics are tested for their tolerance for carbohydrates.

The work recently accomplished by Burian, Shittenhelm, Wiechowski, and others, has demonstrated that the purine bases undergo oxidation by means of enzymes irregularly distributed in various animal species: they are chiefly found in glandular organs, especially the liver, spleen, and pancreas. It has been found possible to separate and, to some extent, purify these enzymes, and to study their action on various purine derivatives. The oxidation of hypoxanthine to xanthine and of xanthine to uric acid are ascribed to one enzyme—xanthine-oxidase.

The oxidation of uric acid to allantoine—

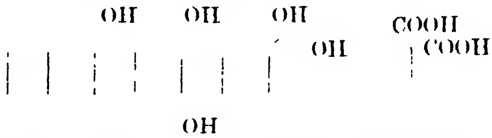


uric acid allantoine

is effected by uricase, an "uricolytic" enzyme. Nothing is known of the decomposition of allantoine by enzymes. According to Wiechowski allantoine is the normal end-product of purine metabolism in the carnivora.

Aromatic hydrocarbons undergo an oxidation with introduction of hydroxyl groups in the nucleus or oxidation of the side chain with formation of acids.

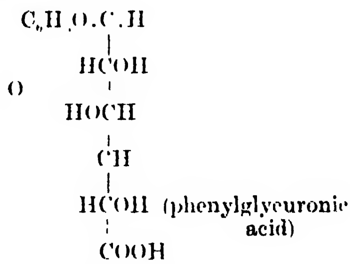
Jaffé fed dogs with benzene and found small quantities of muconic acid in the urine. On feeding muconic acid to rabbits he found that it was exceedingly easily oxidised. A certain amount of benzene probably undergoes complete oxidation in the body. The successive steps of such oxidation are not known, but the following have been suggested—



benzene phenol quinol catechol Muconic acid by rupture of the benzene ring.

Phenols formed thus are not excreted as such, but in combination with sulphuric acid and glycuronic acid.

Salkowski and Neuberg have determined the constitution of phenylsulphuric and phenylglycuronic acids: $C_6H_5O.SO_2.OH$ (phenylsulphuric acid)—



Ethylbenzene, propylbenzene, and toluene are oxidised to benzoic acid and excreted as hippuric without formation of phenols. This reaction may be imitated *in vitro* by the action of H_2O_2 and O_3.

But a remaining large number of aromatic compounds undergo substitution of H groups in the nucleus by OH groups. When benzene is ingested a part escapes unchanged by the lungs (Nencki and Sieber).

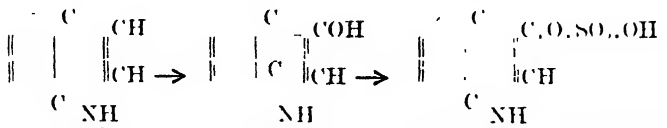
The bacterial decomposition of tyrosine in the intestine produces phenol and paracresol, which partly combine with sulphuric and glycuronic acids, and escape by the urine. A considerable portion of the phenol is oxidised to quinol and later to catechol, which are excreted as conjugation compounds with the above acids.

The three cresols are excreted in large measure with H_2SO_4.

No intermediate product of the oxidation of ethyl alcohol has been found in the body; it is probable that acetic acid is formed and subsequently completely oxidised.

The oxidation of aldehydes has been referred to in connection with mention of the Cannizzaro reaction. Nencki found indole amongst the products of the putrefactive decomposition of proteins by bacteria in the intestine.

Jaffé showed that this was the body from which urinary indican was formed. Brieger isolated the potassium salt of indican, and showed that acids hydrolysed it to indoxyl and sulphuric acid. Indican is known as indoxyl-sulphuric acid. A more correct designation is indyl-hydrogen-sulphate.



indole indoxyl indyl-hydrogen-sulphate

TANNING INDUSTRY OF THE PHILIPPINES.

An effort is being made to stimulate and develop the leather industry in the Philippine Islands. It is estimated that the producers and tanners of hides could save £70,000 annually by investing but little more capital than is now employed, simply by adopting modern methods. It is estimated that about 18,000 skins are tanned annually in the islands. The leather produced is manufactured into slippers and shoes of the lower grades. The value put upon this annual output of the tanneries is about £30,000. There are many skins—from deer, wild hogs, etc.—of which no use whatever is made.

The 125 tanneries are scattered through various provinces. Those of most importance are in Manila, Iloilo, Bulacan, Ilocos Norte and Ilocos Sur. The tanning is poorly done and from poorly selected skins. As a result, thick skins for making hard, thick sole leather come from the tanner flexible and incompletely tanned, through the use of weak tanning solutions and insufficient time in the tanks or vats. Not infrequently these leathers are not sufficiently tanned to prevent decomposition. At best such leathers are of light weight and porous and flexible.

The Bureau of Science recommends that four months be devoted to the tanning process. The process proposed is to immerse the skins first in a solution containing about one half per cent. of tannin and pass them gradually to baths of stronger solutions, the last solutions containing 10 to 15 per cent. of tannin. The present practice is generally to immerse the skins in a strong solution at first and allow them to remain only four or six weeks. The result is preserved skins rather than leather.

The Philippines are rich in tanning materials, which, properly employed, would make locally produced leather not only of the highest class, but also cheaper than that produced elsewhere. The mangroves, which abound in different parts of the islands, and the camanchile tree (*Pithecolobium dulce*),* which grows in great abundance in the Philippines, furnish a large percentage of tannin. The fresh bark of these contains often 15 to 25 per cent. tannin, but as a rule no more than 10 per cent. is utilised.

The cost of 100 kilogrammes (220·46 lb.) of camanchile bark is 24s.; about 10s. to 12s. of bark is needed to tan a hide that in finished form should be worth £3, but because of its poor quality the leather turned out is worth only about £2.

Investigation of the present system reveals great wastage. In one tannery 1,500,000 lb of bark was used, but it was found that only 40 per cent. of the tannin was utilised. Again, a poor quality of lime is used for depilation, and care is not exercised in the washing process. The tanned product is dried too rapidly; the thick skins are divided until they are fragile and more or less valueless.

According to a report by the correspondent at Manila of the Unites States Department of Commerce, the Government is endeavouring to reform the tanning methods, and also to create marketing facilities for handling all the available hides of the islands. A propaganda has been started by the Bureau of Science to induce small dealers in remote communities to purchase hides from producers with the assurance that they will find a ready market at Philippine tanneries. By teaching the tanneries the latest methods it is hoped to stimulate a keener interest in the industry and encourage them to expand.

An insignificant amount of hides has been exported during the last few years. In 1914, 23,486 lb. of carabao hides were exported to the British East Indies and Hong-Kong, and 101,435 lb., valued at £1,859, of hides of all other classes, principally to China and Hong-Kong, although small amounts were shipped to British East Indies, the United Kingdom, and the United States. This represents the high-water mark of hide exportation in the last few years.

* A Mexican tree, having edible pods and a bark rich in tannin; introduced from Mexico into the Philippines and Guam.

ENGINEERING NOTES.

Reduction Gear for Battleships.—The *Times* states that the adoption in America of this gear is of great importance; and second only in interest to the electric propulsion in the "California" is the use of mechanical reduction gear in the 31,000-ton battleships "Pennsylvania" and "Arizona," both of which are to be completed next year. These are quadruple-screw turbine vessels, the former being equipped with Curtis machine and the latter with the Parsons type. The two inner propellers are driven by the main high-pressure turbines, while each wing propeller shaft is coupled to main low-pressure ahead and astern turbines in the after engine-room, and to a high-pressure cruising turbine in the forward engine-room driving the shaft through a reduction gear. When the vessel is steaming under full power the cruising turbines are not in use, and the couplings between them and the low-pressure turbines are disconnected. Under cruising conditions the steam passes first into each cruising turbine, then through it the high-pressure turbine nearest it (which thus becomes an intermediate pressure turbine), and finally to the low-pressure turbine to which it is coupled. By this means it is thought that great economy will be effected, since the cruising turbines are designed specially as high-speed machines running at 2,500 revolutions per minute in the case of the "Arizona," and at 1,850 revolutions per minute in the "Pennsylvania," while the maximum speeds after reduction are 192 revolutions per minute and 120 revolutions per minute respectively. With this combination the efficiency of a high-speed turbine is gained with a low-speed propeller In the "Arizona" the power of the cruising turbine is 2,000 h.p, and in the "Pennsylvania" 1,600 h.p. The gears have been built by the Westinghouse Company, and the weight of each is in the neighbourhood of ten tons. They are provided with floating frames, which it is claimed render the pressure uniform on all the teeth under all conditions of load.

A High-speed Electric Railway.—A 2,400-volt third-rail electric railway—the first ever built to use such a high voltage with the third rail has just been completed in Southern Michigan. The line is owned by the Commonwealth Power Railway and Light Company of Grand Rapids, and has just been turned over to the Michigan Railway, the operating company. It consists of a new line, fifty miles long, from Kalamazoo to Grand Rapids, and branches to Battle Creek and Allegan, obtained by buying and electrifying a forty-four and a half mile branch of the Michigan Central Railroad connecting these two points. The Kalamazoo and Grand Rapids section represents the latest type of electric-railway construction, being designed for heavy loads and speeds up to ninety miles per hour. Except in the streets of Kalamazoo, and of a section of private land in Grand Rapids, the maximum curvature is 3°, and the maximum grade 1 in 100. Along the main line the third rail is an 80-lb. low-carbon rail rolled specially for this road, and on industrial sidings and passing tracks a 52-lb. relayer is used instead

Aeroplane Construction in Australia As a direct result of the war a new industry seems likely to be started in Australia, namely, the manufacture of aeroplanes. Recently we learned from the *Ironmonger* that the Australian Minister for Defence had drawn the attention of engineering firms to the project, and asked such firms to submit tenders for building aviation motors in the Commonwealth. Engines have hitherto been imported, but such importation has ceased as a result of the war. The Defence Department has received many inquiries, and firms from all over the Commonwealth have announced their willingness to build the necessary engines. The engine required is of the Renault type. It is expected that some orders for specimen engines will shortly be given. Meanwhile a staff of mechanics at Point Cook is working at the construction of a biplane, and further machines will be built as soon as possible

Mining Difficulties in Lapland—To deal with an annual output of four million tons of iron ore at Kiruna, within the Arctic Circle, electric machinery is largely used. A mining expert describes the electric shovels for loading the ore into the trucks. The power is obtained from the Parjus Falls, and is conveyed on two lines at a tension of 70,000 volts to Kiruna, where it is stepped down to 110 volts for the shovel motors. The shovels are of a heavy and substantial type. As a protection against low temperatures, the power chamber at the Falls is underground, blasted out of the solid rock, its roof being 50 feet below the surface.

Aero Engineering.—An article in the *Engineering Record* of New York states that new branches of engineering which appear from time to time and are novelties for a while, almost without exception develop into important fields, in which specialists are trained, and which finally become closely identified with the necessities of civilisation. Such will undoubtedly be the case with aeronautics. It is interesting to note the variety of influences which are working to develop the art of flying to a point where it will be more useful than at present. The greatest of these, of course, is the need for aircraft in military operations, and no doubt much progress toward the production of safer and more effective machines will result from the urgent need in the present European conflict. Recently, on the occasion of an accident to a pleasure boat, just off shore from a popular beach resort in California, it was demonstrated that an aeroplane could be used effectively for dropping life-preservers to persons struggling in the water beyond the surf line. This incident started a campaign to have the life-saving service equipped with aeroplanes. The plan, if successful, would

greatly increase the effectiveness of that department in carrying aid to vessels in distress. Post-office officials in Washington have long recognised the advantage of using aero delivery service for crossing the deserts and mountains of the west and north, and in many cases where the means of communication are uncertain it seems almost a necessity. Even in well-settled districts mountain chains often necessitate circuitous rail routes, and these afford opportunity for great time-saving if aerial mail services were established For example, a letter leaving Portland, Oregon, on Monday, does not reach Eureka, California, *via* San Francisco, until Thursday, yet the stretch which causes the delay could be bridged by a two-hour aerial run between Eureka and Redding, California, which are only 95 miles apart as the crow flies. Those whose duty it is to watch for forest fires, to patrol transmission lines, or to carry relief into frozen wastes or the desert areas, and, in short, many whose work is now accomplished under difficulties because of transportation problems, will be able greatly to increase their range and efficiency when the aeroplane as a safe and well-controlled conveyance, is at their disposal.

Electric Railway Progress in England —The first section of the large mileage which the London and South Western Railway has converted from steam to electric traction will be opened shortly, and serves as a reminder of the important work in this field which is now being carried out by British railway companies. Both the London and South Western and London and North Western Railways are engaged in the equipment for electrical operation of an aggregate of some hundred miles of track, and, in spite of delay caused by the difficulty of obtaining the necessary supplies and the shortage of labour, even the stress of war conditions is only retarding and not stopping progress with the work The system which is being installed on the railways to which reference has been made is, with certain modifications, the same as that which has been long tested under service conditions on the London underground railways. Even the system adopted by the Brighton Company, although there is only one other example of it in Great Britain, cannot be regarded as a novelty, as the single-phase alternating current method of working has been largely employed on American and other foreign railways It has been left for the Lancashire and Yorkshire Railway to attempt something new, as far as the United Kingdom is concerned. After experience of the high-tension overhead direct current system which has been experimentally installed on the Bury-Holcombe Brook line, the section of railway between Manchester and Bury is being equipped with high-tension direct current on the third-rail system. It is satisfactory to learn that in some branches of electric railway work British engineers are keeping abreast of the times. The above particulars are from the *Times Engineering Supplement.*

NOTES ON BOOKS.

THE DEVELOPMENT AND PROPERTIES OF RAW COTTON. By W. Lawrence Balls, M.A. London A. & C. Black, Ltd. 5s. net.

The principal object of this work is to present the history of the development of cotton-lint. The author was formerly botanist to the Khedivial Agricultural Society of Cairo, and to the Egyptian Government Agricultural Department, and for some ten years he kept records of field crops in the form of plant-development curves The net result of his observation goes to prove that cotton is a law-abiding plant, and not the capricious crop that it has often been supposed to be.

Mr Balls begins with the development of the pedigree of the plant, and in this chapter he has some interesting views on the question of seed distribution by wind and the evolution of lint His second chapter deals with the development of the plant, including the effects of irrigation, sunshine, manure, quality of the soil, etc , the third and fourth with the development of the boll; the fifth with the development of commercial lint, and the sixth with the development of cotton-growing Two appendices are devoted to the methods of investigation and tables of statistical data

The book is of particular value because hitherto little accurate observation has been kept upon cotton, in spite of its enormous financial importance Though the author's experience was chiefly confined to Egypt, no doubt many of his conclusions will be applicable to the crops grown in other parts of the world The book is thoroughly complete and scientific in its treatment of the subject, and should prove valuable to all interested in the production of cotton

PHILLIPS' PAPER TRADE DIRECTORY OF THE WORLD, 1914 15 London: S. C. Phillips & Co. 15s. 6*d*.

An immense amount of information relating to the paper trade is contained in this volume, and its international character is shown by the fact that some of the articles are printed in seven languages, including Russian. In the case of enemy countries it has, of course, been impossible to obtain reliable information, but in all other cases no efforts have been spared to secure the most recent statistics.

The principal features of the book include lists of the paper mills of the world, with a classification of the various makes of paper, the wood-pulp mills of the world, buyers of paper, boards and stationery, and makers of millboards, leather boards, paper agents, export paper shippers, etc., together with much other information likely to be useful to those engaged in the paper trade.

A list of the paper mills in thirty-six countries of the world shows that the United States come first, with 1 012 mills, Germany second with 895; Italy third, with 426; Austria-Hungary fourth, with 417; France fifth, with 383; and Great Britain sixth, with 356.

GENERAL NOTES.

Agriculture in the United Kingdom.—A summary with comparisons for 1914, based upon the preliminary statements made in June last, has just been issued by the Board of Agriculture, showing the areas in the United Kingdom under crops and the number of live stock on agricultural holdings. The area for wheat was 2,334,090 acres, an increase of 429,160 acres on the year; barley covered 1,523,980 acres, a decrease of 347,190 acres; whilst the area under oats was 4,148,050 acres, an increase of 270,090 acres. Potatoes accounted for 1,202,520 acres, an increase of 5,510 acres, but in the cases of turnips and swedes, mangolds, clover, sainfoin, and permanent grass for hay there were decreases varying from 7·7 to 1·1 per cent. Under the heading of live stock the total number of horses returned was 1,699,640, including 1,214,290 animals used for agricultural purposes. On the total there was a decrease of 142,920 in the number of horses. Cows and heifers in milk or in calf numbered 4,476,470, as compared with 4,576,850, a decrease of 100,380. Other cattle were accounted for as follows: Two years old and above, 2,217,760, a decrease of 108,820; one year old and under two, 2,655,570, an increase of 67,720; under one year, 2,781,570, an increase of 128,290. The gross total number of cattle is given at 12,131,370, compared with 12,144,560 in 1914, a decrease of 13,190. The total number of sheep was 28,181,540, an increase of 295,450 on the year, while pigs numbered 3,783,780, as compared with 3,939,890 in 1914.

Iron and Steel Institute. — The Autumn Meeting of the Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, on September 23rd and 24th. The following is the list of papers that are expected to be submitted for reading and discussion. (1) Wesley Austin, M.Sc., "Influence of oxygen on some properties of pure iron"; (2) T. H. Byrom, "Note on the carburisation of iron at low temperatures in blast furnace gases"; (3) Professor E. D. Campbell, "Influence of heat-treatment on the specific resistance and chemical constitution of carbon steels"; (4) Professor C. A. Edwards, D.Sc., and H. Kikkawa, "Effect of chromium and tungsten upon the hardening and tempering of high-speed tool-steel"; (5) W. H. Hatfield, D.Met., "Phosphorus in iron and steel"; (6) Professor K. Honda and H. Takagi, "The magnetic transformation of cementite"; (7) R. H. Smith, "Sulphur in malleable cast iron"; (8) Professor N. Tschischewski, "Iron and nitrogen."

Japanese Watch Crystal Industry.—A Japanese industry, concerning which little has hitherto been heard, is the manufacture of watch crystals. This is, perhaps, due to the fact that this class of goods has heretofore been purchased mainly from Germany and Switzerland There is, however, a firm in Osaka which is making these glasses in large quantities and exporting them to Manila, Shanghai, and Hong-Kong; the firm also supplies the watch dealers in Japan, Osaka being the distributing centre for the southern, and Tokio for the northern section of the Empire. The glasses are not made in one large factory, but at about fifteen places in Osaka the firm's workmen are manufacturing the glasses as a home industry. The wholesale prices per gross, delivered at Osaka ready packed for shipment, are: fine, 2*s.* 7*d.*; misconcoves, 3*s.* 8*d.*; roscop, 4*s.* 9*d*; round edge, 12*s.* 6*d.*; glass, 1*s.* 8*d.* The United States Consul at Kobe, in reporting the above particulars, remarks that he is unable to say how the quality of the glasses compares with those of European manufacture.

Chinese Wood-Oil in Florida.—The adaptability of the Chinese wood-oil tree for cultivation in Northern Florida seems to have been proved by recent experiments, says a United States Commerce Report. A tree at Tallahassee, Florida, bore two bushels of the fruit last season. In addition to being a tree of economic importance, it is a decidedly ornamental one, bearing clusters of white flowers with reddish-yellow centres, and in full bloom resembles a catalpa. The United States imports annually about 5,000,000 gallons of Chinese wood-oil, valued at $2,000,000 (about £400,000). As the demands of the American varnish trade are steadily increasing, this affords a very large domestic market for this prospective new Florida industry. The tree is *Aleurites cordata* (Chinese Tung yu), the seeds yielding the nut from which the oil is extracted.

Textile Production in Korea.—According to a statistical report of the production of textile fabrics in Korea in 1914, recently published by the Government-General, cotton cloth heads the list with 19,292,086 yards, valued at £806,000, and hemp cloth second with 13,441,087 yards, valued at £223,000. In addition to these, £562,000 worth of T-cloths, silk cloths, and other textiles were produced during the year. Practically all of these goods were produced by home industry, as there are no factories in Korea for the production of these articles.

Calais-Hankow Railway.—On June 16th work was commenced on the breaking through of the wall on either side of the Chien Men, for the purpose of making the two new gateways. The work is being undertaken with the object of making a central station for the Pekin-Mukden and Pekin-Hankow railways. It is interesting to note that when this work has been completed, and the two lines have been connected, it will be possible to go by rail direct from Hankow to Calais. This will form the longest railway connection in the world.

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FRIDAY, SEPTEMBER 24, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICE.

EXAMINATIONS.

The results of the 1915 Examinations have now been published in a pamphlet of 139 pages, folio, which can be obtained at the Society's offices, price 1s., or by post 1s. 3d.

They had previously been communicated to all the candidates.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

FOODSTUFFS.

By DAVID SOMMERVILLE, B.A., M.Sc., M.D.,
Assistant Professor of Hygiene and Public Health, King's College, London

Lecture III.—Delivered May 10th, 1915.

From the above brief outline of what is known of the few substances discussed, it will be seen that any true knowledge of metabolic processes can only be obtained by the tedious work of unravelling complex biochemical changes into individual chemical reactions. We will now glance at the more practical side of this subject.

Pettenkofer and Voit experimented on a fasting man, and from the amount of oxygen consumed concluded that the fasting organism supports itself by the combustion of its own protein and fat. They saw that the quantity of oxygen needed in metabolism depends on the kind of material burnt; that the "respiratory quotient" [ratio of CO_2 expired to O inspired as measured by volume, $\frac{\text{vol } CO_2}{\text{vol } O}$] when carbohydrates are oxidised is 1, when proteins burn 0·78, and when fats burn 0·71.

In writing of their work Voit says: "We found that in starvation protein and fat alone were burnt; that during work more fat was burnt; and that less fat was consumed during rest, especially during sleep; that the carnivorous dog could maintain itself on an exclusively protein diet, and if to such a protein diet fat were added the fat was almost entirely deposited in the body; that carbohydrates, on the contrary, were burnt no matter how much was given, and that they, like the fat of the food, protected the body from fat loss, although more carbohydrates than fat had to be given to effect this purpose; that the metabolism in the body was not proportional to the combustibility of the substances outside the body, but that protein which burns with difficulty outside metabolises with the greatest ease, then carbohydrates; while fat, which readily burns outside, is the most difficultly combustible in the organism."

Voit showed that muscular work did not increase metabolism, and that the metabolism was not proportional to the oxygen supply. His experiments showed that the absorption of oxygen does not cause metabolism, but rather that the amount of the metabolism determines the amount of oxygen to be absorbed.

Rubner, carrying on Voit's work in the Munich school by a series of most careful experiments in which all food and oxygen entering the body and all carbondioxide, water, urine and faecal matter leaving the body were controlled and accurately analysed, was led to formulate his famous isodynamic law, viz., that the foodstuffs replaced each other in accordance with their calorific value. That this law does not hold in all respects has been demonstrated by modern work.

Rubner drew another important conclusion, viz., that the heat value of the resting individual is proportional to the area of the surface of his body.

In connection with the analytical work Rubner found that the value of a gramme of dry faeces was 6·2 calories and was very constant, whether the subject was on a meat or a mixed diet.

The ordinary faeces indicate whether a given food is a small or a large faeces producer, but not how much or how little food has been used

by the organism. There is practically little or no difference between the digestibility and absorbability of animal and vegetable foods.

It has been stated that the cold-blooded ancestors of warm-blooded animals changed their habitat from the sea to the land in the tropics at a temperature which is now the inheritance of their descendants, and that in the course of development these animals acquired the power to maintain that ancestral temperature. The nervous mechanism by which this is effected is: (1) chemical regulation of temperature by which an increased production of heat appears in the presence of external cold; and (2) physical regulation of temperature by which variations in the quantity of blood supplied to the skin modify loss of heat through radiation and conduction, and variations in the amount of sweat modify the loss of heat by evaporation of water.

Heat is lost by conduction and radiation, by evaporation of water from lungs and skin, by warming food ingested and by warming inspired air. Roughly, heat elimination is proportional to surface exposed.

Cold baths increase metabolism. The respiratory quotient indicates that the increased metabolism is at the expense of glycogen. There is an after-effect which lasts about an hour and a half.

Experiment shows that if instead of natural foods purified materials such as egg albumin, casein, vitellin, starch and oleomargarine with the proper salts be mixed and given to animals the offspring are difficult to rear on the same food and no living young can be obtained from the second generation. Artificial foods cannot replace natural foods. The influences of protein food on nutrition are various: when protein alone is digested it is readily oxidised and only with the greatest difficulty deposited as new tissue.

If that quantity of meat be administered which is equal to what is oxidised in starvation nitrogen equilibrium will not be established, but some of the body tissue will also be metabolised. This last grows steadily if the amount of meat ingested be gradually increased till the point of nitrogen equilibrium is reached, at which the amount of meat ingested is equal to that destroyed in the body. Nitrogen equilibrium may be present whilst the body loses fat, *i.e.*, one may have nitrogen equilibrium without carbon equilibrium. A knowledge of this underlies systems of diet for the obese. In these cases loss of protein is undesirable, whilst loss of fat is the greatest relief. Gelatin contains almost as much nitrogen as protein; it yields the same amino-acids, with the exception o tryptophane, tyrosine, and cystine; in the diabetic it yields the same amount of sugar as protein; but no matter how much of it is ingested, it is all burnt and body protein in addition. Gelatin, therefore, never builds new tissue; it cannot be converted into protein nor act like protein in metabolism. Gelatin, however, like carbohydrates, spares protein. If the lacking tyrosine, tryptophane and cystine be added to gelatin in the proportions found in true protein the mixture maintains nitrogenous equilibrium in man and the dog.

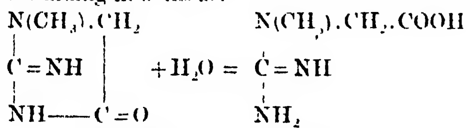
Abderhalden fed a dog with 25 grammes fat, 50 grammes starch, 10 grammes cane sugar and 5 grammes dextrose, and brought it into nitrogen equilibrium with meat containing 2 grammes nitrogen. He then substituted for the meat the amino-cleavage products of casein produced by pancreatic digestion, and also containing 2 grammes of nitrogen. For sixteen days there was an average daily gain of 0·12 gramme of nitrogen. He then hydrolysed casein by acid and administered the cleavage products as before containing 2 grammes of nitrogen. For ten days the dog lost 0·53 gramme of nitrogen daily. This is the experimental evidence of the statement above that acid hydrolysis cannot replace natural enzymic hydrolysis. Henriques hydrolysed protein with trypsin and erepsin, and then treated it with 20 per cent. H_2SO_4 on the water bath, obtaining amino-acids with no admixture of polypeptides. He found that as long as the mixture gave a pronounced tryptophane reaction it supported the organism in nitrogen equilibrium. In the absence of the single amino-acid tryptophane nitrogen equilibrium cannot be attained. In practical dietetics cleavage products of proteins have no value. Albumoses and peptones, when given in quantity, produce diarrhœa.

Serum albumin contains 7·7 per cent. glutamic acid; serum globulin 8·5 per cent. Abderhalden administered 1,500 grammes of gliadin containing 36·5 per cent. glutamic acid, but the percentage of glutamic acid in both constituents of the serum remained unchanged. A new construction of protein in the body from synthesis of amino-acids formed in digestion is characteristic of the organism and not of the proteins ingested. A copious drinking of water appears to remove accumulations of nitrogenous decomposition products and at the same time to cause a small but true increase in protein

metabolism. Abderhalden found that homogentisic acid is an exception to this rule in the case of the alcaptonuric.

Voit concluded that the cleavage of the protein molecule produced a nitrogenous and a non-nitrogenous portion, that the nitrogenous portion was rapidly burnt and that the non-nitrogenous part was temporarily stored for future combustion as needed. It has been shown that in diabetes the amino-acids are deaminised with formation of ammonia and organic oxyacids; these acids are directly available for oxidation or for conversion into dextrose. The heat and other energy values of protein lie in this denitrogenised remainder. Thiele has shown that in a cystinuric patient the same quantity of cystine is excreted in the urine, whether the patient be starving or fed with carbohydrates, with meat or with cystine which he has himself excreted. But the cystine of his own excreta and also that of meat were destroyed when ingested by the mouth. Thiele argues that this destruction occurred in the intestinal mucosa. The view most generally held by modern workers is that deaminisation occurs in the mucosa.

A diet containing a medium amount of protein produces no more creatinine and no more uric acid in the urine than a diet almost free from protein. This led Folin to distinguish an endogenous from an exogenous protein metabolism as represented by the urea eliminated which is in greater part derived from ingested protein. Creatinine is not influenced by muscular work nor by the increased protein metabolism following phosphorus poisoning. Creatinine ingested is largely eliminated in the urine. Mellanby finds that creatinine is not excreted in chickens until the muscles are saturated with creatine. Possibly the creatinine formed in metabolism is converted into creatine for building new tissue.



creatinine creatine

Normal urine does not contain creatine; creatine is not a product of endogenous metabolism. When ingested it may be destroyed or excreted in the urine, but not converted into creatinine. It frequently appears in the urine as an indication of destruction of muscle, *e.g.*, in involution of the uterus, carcinoma, fasting, phosphorus poisoning. We know nothing chemically of the origin of creatinine.

Creatine is the extractive found in largest quantity in muscle. In Liebig's extract it is largely converted into creatinine. It is ready for elimination in the urine, and is therefore of no value as a food.

The production of fat from protein was clearly demonstrated by Cremer, who starved a cat until its glycogen disappeared, and fed it on lean meat. The carbon of the meat ingested was calculated at the low ratio of 3·18 to 1 of nitrogen. There was a daily excretion of 13 grammes of nitrogen, corresponding to the liberation of 41·6 grammes of protein carbon. But only 34·3 grammes carbon were actually eliminated. The difference, 7·3 grammes, or 17·5 per cent. of protein carbon, was not eliminated. During eight days the whole carbon retention was 58 grammes, corresponding to 130 grammes of glycogen. The glycogen obtained when the cat was killed amounted to only 35 grammes. The difference must have been stored as fat. It is very possible that the origin of fat from protein is of the same nature biochemically as its origin from carbohydrates.

That animals can convert carbohydrate into fat has long been known. Weinland expressed ferments from living ascaris which convert glycogen into dextrose, and dextrose into valerianic and caproic acids. When carbohydrates are converted into fat in the animal the respiratory quotient may rise considerably above unity; an oxygen-rich substance is being converted into a substance poor in oxygen. The intramolecular oxygen of the carbohydrate becomes available for the formation of CO_2, and accordingly the requirement for inspired oxygen diminishes. Before the setting in of winter hibernating animals instinctively devour large quantities of carbohydrates.

Chittenden finds that nitrogen equilibrium can be maintained on a diet containing a very small amount of protein and two-thirds the body's requirement of energy. When Chittenden's practice is applied to obese patients, the other third of the necessary energy is furnished by the body's own fat.

Rubner showed that a man developing mechanical energy to the extent of 15,000 kilogramme-metres per hour, excretes the same quantity of CO_2, no matter what the temperature of the atmosphere may be. In other words, during mechanical work the influence of the "chemical regulation" of body temperature may be eliminated. The extra heat produced in performing mechanical work is utilised instead of the production of heat which is excited reflexly through cold.

It has been definitely settled by numberless experiments that muscular work does not increase protein metabolism, and that the character of the metabolism is not changed by muscular exertion. The total nitrogen and its individual constituents, the sulphur, etc., in the urine, remain unchanged despite the widest variations in degree of muscular activity. In this connection it may be mentioned that training has an influence on metabolism. A trained mountaineer performs his work at the expense of less metabolism than does the untrained. But training affects only the muscles involved in the particular movement and not those which remain inactive.

For a man doing average muscular work such as a soldier, Voit held that a normal diet should consist of protein 118 grammes, carbohydrates 500 grammes, fat 56 grammes. This diet produces 3,055 calories.

For men at hard labour this ration was considerably increased. Chittenden has disturbed the traditional view that for the maintenance of bodily vigour a liberal allowance of protein is necessary. He is of opinion that one-half the quantity of protein previously advocated is sufficient for the maintenance of excellent health. It is certain that large ingestion of protein in hot weather increases the heat production with increase in perspiration. In cold weather, however, an extra heat production may be of service. For man living in cold climates there appears to be no argument against the use of a medium amount of protein in accordance with the dictates of appetite. A dietary of 2,500 to 2,600 calories is not sufficient for a soldier at drill.

Milk, with its high protein content, is a food *par excellence* for the growing child, or the invalid convalescing from wasting disease. It contains too much protein for a normal adult. An exclusive milk diet is deficient in iron.

Milk alone has been recommended in the treatment of obesity in quantities varying between 1·5 and 2·5 litres a day. To meet a requirement of 2,400 calories daily, 3,400 grammes of milk would be required containing 140 grammes of protein.

A significant fact concerning the nutrition of the young is that the milk of a given race is *specifically adapted to the growth of the offspring* of that particular race. The milk of the bitch has an ash exactly the same in composition as that of the new-born puppy. The ash of this milk is therefore perfectly adapted for the building of puppy tissue. It differs, however, very considerably from human milk, or the milk of the cow or other animal. Again the caseins of different animals are different in their chemical behaviour. Also the rennin of the gastric mucosa is specially adapted for coagulation of the casein of the milk of the same race. The calcium content of cow's milk is in excess of the needs of the human infant. The differences in composition of human and cow's milk are so great that there is no escape from the conclusion that cow's milk is not to be substituted for human in rearing a child. Human milk, after the first month of lactation, contains a little more than 1 per cent. casein as against more than 3 per cent. in cow's milk. Cow's milk contains but little extractive nitrogen, whereas in human milk 18 to 20 per cent. of the total nitrogen may exist in that form. This is probably the reason for the $\frac{C}{N}$ ratio in the urine of breast fed infants reaching a figure greater than unity.

Fresh cow's milk and its serum are both acid to phenolphthalein, and alkaline to methyl orange. These reactions indicate that the acidity is due to acid phosphates. Phosphates cannot be titrated with any degree of accuracy in presence of calcium; some of the soluble dicalcium phosphate ($CaHPO_4$) formed during titration hydrolyses into calcium hydroxide and phosphoric acid –

$$CaHPO_4 + 2H_2O \rightleftharpoons Ca(OH)_2 + H_3PO_4.$$

The newly-formed calcium hydroxide reacts with more dicalcium phosphate to form tri-calcium phosphate

$$Ca(OH)_2 + 2CaHPO_4 \rightarrow Ca_3P_2O_8 + 2H_2O.$$

Dibasic phosphates are neutral to phenolphthalein. Monobasic phosphates are acid to phenolphthalein. Phosphoric acid acts, therefore, as a dibasic acid to phenolphthalein. The molecule of free phosphoric acid formed above increases the acidity of the milk containing dicalcium phosphate. If the fat and dicalcium phosphate be removed from the milk by a Pasteur-Chamberland filter the acidity of the serum is reduced to about one half. Mono-calcium phosphate may be correctly estimated by first removing calcium by neutral potassium oxalate. After treatment with potassium oxalate the acidity of the milk is the same as that of its serum. Thus two classes of compounds are met with, those in true solution and those in suspension or insoluble. The constituents wholly in solution are sugar, citric acid, K, Na, Cl. Those partly in solution and partly in suspension

are albumin, inorganic phosphates, Ca, Mg. Albumin seems to be adsorbed to a considerable degree by casein, so that only a part of it appears in the serum. Serum from sour milk, and milk to which formaldehyde has been added, contains nearly all the albumin. The insoluble filtered portion consists of Ca_3, casein, and $CaHPO_4$, not in combination. By treating milk with formalin, and whirling in a centrifugal machine, it is possible to effect a nearly complete separation between phosphates and casein (L. van Slyke and Bosworth).

Sikes finds that in human milk the average amount of P_2O_5 during the first fortnight of lactation is 0·0297 per cent., varying between 0·0140 and 0·0522 per cent.; that the percentage of the non-protein P_2O_5 averages 0·0169, and of the protein P_2O_5 0·0124; that the ratio of the protein P_2O_5 to the total P_2O_5 averages 42·3 per cent. He finds that the average amount of Ca in human milk in the first fortnight of lactation is 0·0301 per cent.; that the greater portion of the Ca is combined with the protein, as the ratio of the protein calcium to the total Ca is, on an average, 84 : 100. When both the Ca and the protein were estimated in the same samples, the Ca was found to average 1·06 per cent. of the total protein.

When it is considered that Ca, estimated as oxide, is found in cow's milk to five times the extent that it exists in human milk, it is easy to conceive that the assimilation of cow's milk by the infant is a very different proposition from assimilation of that of the breast. The large quantity of calcium alters the characters of the casein in relation to rennin and the proteoclastic ferments.

Osborne and Mendel have pointed out the dominant importance of certain amino-acids in the problems relating to the function of the nitrogenous intake in both maintenance and growth. When the content of any essential amino-acid group in a given protein is small, this poverty will not be manifest so long as the diet contains a surplus of this amino-acid above the figure required for maintenance or growth. But on lowering the plane of protein intake a level will be reached where the quantity of the essential amino-acid becomes so small that it cannot satisfy at first the requirements of growth, and later the maintenance need. In other words, the amount of protein available at any time for functions of growth will be limited by the "law of minimum."

It is known that casein yields little cystine. When the diet contains 18 per cent. of casein, together with the essential non-protein components, young rats can complete their growth satisfactorily. With 15 per cent. casein growth is maintained normally. Below 12 per cent. growth falls off slightly. When casein falls to 9 per cent. growth promptly goes down. When cystine to the amount of 3 per cent. of the casein is added to the ration growth progresses favourably.

On 4·5 per cent. casein growth is maintained for a little and then goes down. On 2 per cent. casein growth sharply declines from the first. But cystine is unable to retrieve the failure in growth when casein reaches a level somewhat below 9 per cent.

In the same way it has been shown that edestin which is poor in lysine, can secure normal growth when administered in quantities constituting 15 per cent. of the ration. With 12 per cent. growth is diminished. The addition of lysine, equal to 2 per cent. of the edestin, makes good a normal growth.

No amount of zein food, however large, will retain rats in nutritive equilibrium. A small amount of tryptophane will convert the inefficient ration into an efficient one.

A content of protein utterly inadequate in the case of casein allows good growth when lactalbumin is added.

Young rats fed on purified protein, carbohydrate in the form of starch, and inorganic salts in the form of protein-free and fat-free milk, together with lard, grow normally for about three months, but never attain full size. Sooner or later decline in body weight occurs, with symptoms of malnutrition (eye infections and impaired resistance to bacterial invasion). If instead of lard, butter fat, egg yolk fat, cod-liver oil, or beef fat be used recovery promptly follows. Almond oil and olive oil give negative results. Attempts have been made to separate the "active" substance at work in promoting growth in these fats. Osborne and Mendel have concentrated it by dissolving the fat in alcohol and cooling it to -15°, at which low temperature the higher melting fats crystallise out. The clear alcoholic solution is concentrated at 40° *in vacuo* until the alcohol is completely removed. The growth-promoting properties appear to reside in the clear yellow oil which is left, and not in the white crystalline solid obtained as above.

Failure of nutrition on diets containing lard has been completely restored by the substitution for lard of butter fat, butter oil as above prepared, or commercial oleomargarine.

Osborne and Mendel have published charts

showing the extent to which small proportions – 1 per cent., 3 per cent., 6 per cent.—of butter fat are efficient in promoting growth and to which larger proportions restore growth after decline.

McCollum and Davis publish curves to show that the lowest plane of protein intake derived from milk which can maintain young rats without loss of body weight is 3 per cent. of the ration.

As the plane of protein intake is raised between 3 per cent. and 8 per cent., there is a progressive increase in the rate of growth.

If protein derived from wheat kernel be supplied to the extent of 6 per cent. of the ration, growth takes place at about half the normal rate. A ration containing 4 per cent. of protein from wheat embryo is somewhat better than a similar ration containing 6 per cent. protein from the entire kernel.

Casein and ovalbumin are rich in lysine and promote maximal growth; while zein fails to do so because of its lack of lysine and tryptophane.

These two substances have been shown to spare body protein more than others.

Fully 80 per cent. of ingested proteins and nearly 60 per cent. of body proteins are converted into glucose in the phlorizinised animal. This transformation may be considered as a normal process. The protein-sparing function of carbohydrate has long been known; and it is now clear that utilisation of protein depends on the presence of carbohydrate. Dakin regards oxyaldehydes as metabolites closely related both to amino-acids and glucose. It may well be, as Janney suggests, that glucose and amino-acids break down into oxyaldehydes and ammonia, from which new proteins are synthesised; and that the demand of the starving body for glucose may be but an expression of its need for protein repair. In the later stages of starvation it is probable that the organism uses the degradation of the protein of lower organs for the synthesis of that of higher.

The fact that various proteins yield large amounts of sugar in the diabetic phlorizinised dog has been fully established; and that individual amino-acids yield sugar has also been established. The following amino-acids yield sugar: Glycine, alanine, serine, cystine, aspartic acid, glutamic acid, ornithine, proline. The following are non-glucogenetic: Valine, leucine, isoleucine, lysine, phenylalanine, tyrosine, tryptophane. Whilst unable to produce sugar leucine, tyrosine, and phenylalanine yield an increase of aceto-acetic acid. Janney, in a recent paper, has shown (1) that vegetable and animal proteins under optimal conditions are metabolised at the same rate in the animal organism; and that all the extra glucose and nitrogen are eliminated by the ninth hour after ingestion. (2) Each protein produces a definite amount of glucose in the phlorizinised organism. The various yields represent 50 to 80 per cent. by weight of the protein administered. These yields approximate the ratios which the glycogenetic amino-acids of the proteins in each case bear to the total amino-acids as actually determined by hydrolysis.

Moorhouse, Patterson, and Stevenson find that in experimental diabetes produced by removal of the pancreas, the total metabolism is increased, and the increase corresponds in quantity with the intensity of the characteristic symptoms. This increase ranged from 9 to 38 per cent. The rise of the respiratory quotient which normally occurs after ingestion of glucose or fructose is greatly diminished, or is absent after total removal of the pancreas, indicating that complete oxidation of sugar does not occur. The increase in the excretion of acetone bodies is parallel with the increase in the Dextrose : Nitrogen ratio and with the total metabolism suggesting that the phenomena are expressions of a similar disturbance of protein metabolism, which is secondary to the impairment of sugar utilisation.

Rubner and Richet, adopting the view that heat is produced in the body in order to maintain its temperature at the necessary level of 37° rather than as an incidental occurrence consequent on the degradation of energy, taught that the heat production of animals is directly proportional to the body surface, and that in several groups of animals approximately 1,000 calories per square metre are liberated daily; moreover, that each kilogramme of body substance has the same heat-producing power as every other kilogramme throughout the body. It is known that the surface of irregular but similarly shaped bodies varies as $\sqrt[3]{\text{volume}^{(2)}}$. Benedict, using this formula, collected evidence in his nutrition laboratory to show that the law of heat production per square metre of body surface does not obtain. On the contrary, from data obtained through observations on eighty-nine men and sixty-eight women, all in apparently good health, he found the variations in heat output so large as to exclude all possibility of the existence of any such law. By plotting the total metabolism as measured by the total twenty-four hour heat production against the

body weight, and in like manner heat production per kilogramme of body weight against body weight, nothing in any manner approaching constancy in relationship was found. In man, *e.g.*, heat production per kilogramme of body weight varied over a range of 60 per cent. or more, and in women over a range of 80 per cent.; whilst heat production per square metre of surface varied in men over a range of 40 per cent. and in women over that of 43 per cent. The simple relationships assumed to exist between the size of the body and its heat-producing mechanism, and between the area of the body and its heat requirement are thus shown to be non-existent.

Metabolism is affected in a variety of ways: (1) By variations in the mass of active protoplasmic tissue. Benedict and Smith quote figures to show that in trained athletes basal metabolism according to the three standards of comparison, viz., total metabolism, heat production per kilo of body weight, and heat production per square metre of body surface—is measurably greater than in non-athletic individuals of the same weight and height. (2) By variations in cellular stimulation. Men weighing 50 kilos have been found to produce more heat per square metre of body surface than others weighing 80 kilos. (3) Youths have a very much higher metabolism than adults. (4) Sleep in one case studied showed a lowering of 13 per cent. in the metabolism on the waking hours. (5) Diurnal variations. If the metabolism during the night be taken as a basis, an increase is found in the morning of 13 to 14 per cent. and the late afternoon of 22 per cent. (6) Fasting. After the twenty-third day of a fast the metabolism rose. The tendency to depress metabolism due to previous continued loss of protoplasm by fasting was actually at this date overcome by the unknown stimulus increasing the cellular activity of the remaining body substance. (7) Character of diet. With the acidosis which results from ingestion of a carbohydrate free diet there is a distinct increase in basal metabolism; acids stimulate the cellular activities. (8) Severe muscular work. As a result of excessive muscular activity cellular activity may be increased enormously and maintained at a high level for a considerable period after cessation of work, with a corresponding high though continually decreasing plane of metabolism. It appears then, from accurate measurements made on athletes and on normal men and women, that the metabolism, or heat output of the body, even at rest, does not depend on Newton's law of cooling, and is not proportional to body surface; but that the proportion of active protoplasmic tissue to inert body fat is important (the greater the proportion of active protoplasmic tissue the greater the metabolism). With this must be considered the stimulus to cellular activity as modified by sleep, age, period of the day, fasting, character of preceding diet, and muscular work. No law, however, can be at present stated to cover these two important variables in the basal metabolism of the individual.

Benedict has still more recently studied the metabolism of athletes as compared with normal individuals, when he made observations on the basal metabolism in a post-absorptive state with the patient at complete muscular rest. Each experiment was commenced twelve hours after the last meal. He continued this research to men as compared with women. He found that athletes have a somewhat higher metabolism than non-athletes; and he concludes that the increased proportion of active protoplasmic tissue present in the trained athlete is alone sufficient to account for this increase; and that the catabolism of the body is proportional not to the surface of the body, but to the active mass of protoplasmic tissue. The metabolism of women in middle life is the same as that of men of the same age and body weight. With children and old men and women females have a slightly less metabolism than males. But he finds no law governing the relationship between the total body weight and the total heat production.

Little is known of the chemical changes which take place in foodstuffs that are kept, even under the best conditions for considerable periods of time. Some time ago I investigated the nitrogenous metabolism of growing white rats fed on a diet of crushed wheat three years old. The same number of controls (three) from the same litter were fed in the same manner, on grain three months old. The urinary analyses made were: Total N by Kjeldahl's method, ammonia by Folin's method, urea by the method of Ronchese, creatinine and uric acid by Folin's methods, and P_2O_5 by Neumann's method.

During the six weeks of the experiment the metabolism of the animals fed on the old grain failed in all cases to reach that of the controls fed on new grain, and growth failed to the extent of from 20 to 30 per cent. Urea nitrogen was in all cases lower. In two of the three animals fed on old grain ammonia was in the

average 15 per cent. higher than in the controls. Total nitrogen fell below that of the controls 22 per cent. (mean of 18, 23 and 25 per cent.). P_2O_5 failed to reach the level of that in the controls by 5 per cent. The amounts of creatinine and uric acid were exceedingly small, the latter so small in two of the cases as to be scarcely possible of estimation: in the case of these items also the figures were larger in the controls. I hope to be able to show that one factor in this problem, which may to some extent account for the lowered metabolism, is the increased resistance to proteolytic hydrolysis found in the old grain.

One other remark before leaving the subject of metabolism: whilst it is quite true that a large protein dietary raises the plane of metabolism generally, and protein metabolism in particular, it is reasonable to assume that the increased wear and tear thrown thereby on the body mechanism may, in many cases, make for a premature disorganisation of tissue in important vital organs, thereby shortening the tenure of life. This matter will be referred to later in connection with the putrefactive fermentation of proteins in the intestinal tract.

INDIAN FORESTS.

The quinquennial review of the Forest Administration in India contains a useful summary of the progress that is being made in the development of the forests, which cover no less than a quarter of a million square miles. As regards paper manufacture, the report shows that an encouraging advance has been made. It says that with the assistance of the Titaghur Paper Mills Company, trials in the manufacture of bamboo pulp have been carried out successfully on a commercial scale, and concessions for the extraction of bamboos have been granted to two firms in Burma and Bengal. The outbreak of war has delayed the commencement of manufacture, but as large supplies of the raw material are available the outlook is promising. In the Punjab a concession for the extraction of spruce and silver fir from the Kulu forests for the manufacture of wood pulp has been granted. Matters are less advanced as regards the grass-pulp industry, but this is being seriously considered. In the United Provinces and Assam enormous quantities of suitable grasses are available, and if trials on a commercial scale be successful an important industry may be established.

The extraction of tanning materials has received attention for some time past, particularly in the matter of obtaining a satisfactory extract from the bark of mangroves. For this purpose a factory was established several years ago at Rangoon, but owing to the want of expert supervision was not very successful. In order to test the possibility of producing extracts of good quality on a commercial scale the services of a tanning expert have been obtained and he will probably reach India shortly, bringing with him a small portable plant. The forests of India contain many valuable tanning materials other than mangrove bark. The possibility of utilising these will be examined by the expert, and his appointment may result in the establishment of a new and important industry.

Another important forest industry in which the report shows that marked progress is being made is that of rosin and turpentine production from pine trees. In the Himalayas, in the Punjab and the United Provinces, distilleries have been established, and are now turning out considerable quantities of both rosin and turpentine. The Indian demand for these products, which are largely used in the manufacture of paper, paints and varnishes, is considerable, and the local outturn has already affected imports from other countries. In the Punjab a modern plant has been erected near Lahore and a large increase in the outturn is also expected in the United Provinces.

As regards finance the surplus average revenue per annum in the past five years has been 132 lakhs, as compared with 116 lakhs in the preceding quinquennium, and the report shows that during the past fifty years the surplus has increased nearly ten-fold. These remarkable results are in spite of the fact not only that a substantial portion of the annual expenditure is absorbed by the cost of research and of sylvicultural work, for which no immediate return can be expected, but also that all capital expenditure is met from revenue. There is, too, the fact that each year large quantities of forest produce are given away free or removed by right-holders. The average annual value of the produce so removed is over 62 lakhs of rupees, but this is a rough estimate only and does not represent the amount which would have been realised had the produce been sold. Both in 1912-13 and 1913-14 the surplus was over a million pounds sterling, and the report anticipates that in the near future this figure will be exceeded.—*Times of India.*

CANADIAN MOLYBDENUM.

In view of the great demand for molybdenum, which is indispensable in the production of certain grades of steel, attention is being drawn to Canada as a source of supply. Although it is found in numerous localities throughout the country, there has as yet (according to the Report of the Canada Department of Mines on the Economic Minerals and Mining Industries of Canada) been practically no recovery of the metal in Canada, with the exception of small amounts obtained while developing or exploring properties. Molybdenite deposits in Canada are usually found in the Archaean regions, and are probably due to the influence of masses of granite. Molybdenite occurs in quartz veins, pegmatite dikes (probably connected with the granite masses), and along

contact borders of granite or pegmatite with crystalline limestone.

The most promising deposits, as they were to be seen in 1909 and 1910, were situated in the following places: an island opposite Romaine, Lower St. Lawrence; Aldfield and Egan townships, north of the Ottawa River; the vicinity of Kewagama Lake in the northern part of Pontiac county, Quebec, near the Grand Trunk Pacific Railway; Brougham, Lyndoch, and Ross townships in Renfrew county, Sheffield township, Addington county, and Cardiff township, Haliburton county, in Eastern Ontario; and the Giant Mine, Rossland, British Columbia.

A note about the occurrence of molybdenum in Australia appeared in the *Journal* of May 7th, 1915. It is important that any deposits of the metal within the British Empire should be located, as hitherto we have been almost entirely dependent on Germany for our supplies.

OIL IN CHINA.

In the course of a brief survey of the world's supplies of petroleum, some account is given in the volume on "Petroleum and Natural Gas Resources of Canada," published by the Canadian Department of Mines, of the oil industry in China. Oil occurs chiefly in the Shensi Province, where it has been obtained in small quantities for centuries. At present trifling amounts are obtained by antiquated methods and used locally. In the eastern side of the province there are oil-mills worked with rudimentary machinery under Japanese supervision, but the yield of the wells is small owing to the methods in use. Petroleum, natural gas, and salt-brine deposits are reported by travellers in the interior of the country, but it seems certain that for many years to come China will depend for its supplies of oil upon other countries.

For many centuries in the province of Szechuen, wells from 2,500 to 3,000 ft. in depth have been drilled by a most primitive and laborious method. These have yielded large quantities of salt brine, and natural gas and petroleum in limited quantities, the natural gas being used extensively as fuel to evaporate the brine. The petroleum is of four different qualities. The first is of a very light colour, and is used in its natural state for burning with refined petroleum in special lamps, the second is of a very greenish colour, and is less valuable than the first, the third is yellow; and the last is black, very thick and viscous. The first is also employed by the Chinese for medical purposes, especially for skin diseases and rheumatism. The temperature of the petroleum and brine as they come from the wells is about 250 C., while the temperature of the atmosphere is only about 40 C.

In general the petroleum occupies second place. The salt industry is ancient and is developed. Petroleum production is only of recent date and a side-issue of the salt industry. The refining processes are rudimentary, where they exist at all, and the oil is not sold commercially for illuminating purposes.

Many of the wells are on the side of a hill, which permits of the utilising of the natural fall, whether for running off the salt water into the reservoir and evaporation pans, or for conducting the gas given off from the salt wells, which serves like petroleum for fuel. All the conduits for water, gas, and oil are of bamboo. The work of drilling the well is conducted thus. An ordinary pit is dug until it reaches hard clay, which is usually found at a depth of 200 to 300 ft. In this a wall is built, cone-shaped at the top and with an opening large enough to admit the passage of the cable of a drill. Starting with the first hard layer, the drilling is carried on with a drill, the width of a section being 5 in. × $2\frac{1}{2}$ in. and 20 ft. long, and weighing a little over 130 lb. The strokes are thirty blows to a minute, falling each time 16 in. The last layer before reaching the salt-water stratum is granite and very hard. In some mines the brine is thrown very high into the air when the last layer is pierced, but only for a short time. Any natural gas found with the water is separated and sent by a main pipe to be divided to various salt pans for heating. Certain wells strike rock-salt, in which case a second well is drilled alongside the first, and sweet water is sent down to dissolve the salt.

The largest and one of the oldest springs of natural gas is at Tse-liu-tsin, while that at Chu-pai ching has been in operation day and night for forty years. As much as 400 or 500 lb. of fetid oil, which burns on water, may be obtained from a well in a single day. When a well produces petroleum alone the oil is conveyed to special reservoirs, but where it is found mingled with the brine it floats on the top of the liquid and is skimmed off. Where gas is the chief product of a mine well all the others are neglected. The gas appears to come from two separate horizons—one comparatively near the surface, and the other at a depth of about 720 yards.

ARTS AND CRAFTS.

The Schools. Most of the London schools of art are beginning work this week. Some, more especially the trade and technical schools, both in London and elsewhere, have already settled down to their autumn's work. In most cases the prospectuses are much the same as usual, with here and there a notice that such and such classes are "temporarily suspended." On the other hand, most people are wondering how far the proposed syllabuses will be carried out, and some teachers have been given to understand that there is at least a possibility, not to say a probability, of their classes not being held. If sufficient students present themselves, well and good, but at a moment when the cry is economy it is hardly likely that there will be any bolstering up of doubtful classes. This all seems reasonable enough, if a little hard

upon the teachers involved. We are at war, and we cannot blink the fact. However desirable it may be in normal times to encourage people of leisure to turn their attention to art and the artistic crafts, or to urge young people to take up some more or less artistic hobby as an occupation for fingers which might in their spare time find plenty of mischief to do, there is no need for that kind of thing at present. Older people's spare time can for the moment more profitably be given to war work, whilst the superfluous energy of the average small boy is finding plenty of outlet in scouting, drilling, and the like. In face of all this, some people are inclined to question rather wearily the advisability of continuing art and craft classes on a large scale, and to look upon energy devoted to art as rather misplaced. The idea is easy to understand. Art certainly appears more remote from any practical connection with the war than almost any other subject, and now that we have come to the point when the cry of "Business as usual" is out of favour, there seems little place for art and artistic craftsmanship. However that may be, this much is certain: we cannot expect or desire the schools to be as full as usual, or to be attended by quite the same type of students. But for all that, we can look upon them as doing good service, and that in at least three ways. They are, it is to be hoped, training serious students who will be ready when the stress is over to help, by doing their share, towards seeing that the design of our manufactured goods is better than it has ever been before, and is in fact of such a quality that it will enable us to take all those opportunities which we trust will be ours at the end of the war, and turn them to good account. Further, they are training in ways of craftsmanship boys (such as trade scholars and the like) who are too young for the fighting line, and girls of about the same age who will be infinitely more useful later on, whatever may be the fate of their own particular craft, for having learnt to handle tools with the precision and dexterity which an artistic craft demands, and will be able to uphold the traditions of British craftsmanship. Again, we can look to them for help with the difficult problem of the men who have been discharged from the army, wounded. That statement requires some qualification, of course. The artistic crafts have suffered in the past from the well-meant efforts of philanthropists obsessed with the idea that they offered suitable occupation for the halt, the maimed and the blind, as well as for weaklings of all kinds; and competent authorities in the various industries concerned have reiterated with persistence and reason that this idea is a mistake. On the other hand there are now men—there will probably be more of them later on—who, though incapacitated for military service, are neither weaklings nor cripples, and many of them are young enough to learn a craft successfully. It would, of course, be a mistake to flood the market with craftsmen at a time like this; but there ought to be room for some of these men in the ranks of hand-workers following a more or less artistic calling. Further, from a broader point of view of the situation, though art may seem for the time being almost out of place, it is in reality sorely needed. There is much ugliness around us on every side, and we can do with all the beauty that we can secure.

Woodcarving.—The School of Art Woodcarving, 39, Thurloe Place, South Kensington, S.W., always opens early in September, and is by now hard at work. Though it is one of those institutions which might have been expected to suffer very severely from the war, it did remarkably well this year at the National Competition, gaining thirteen awards in all, including a Princess of Wales's Scholarship and one gold and one silver medal an extraordinarily high number for a school of its size and it has begun work with a good number of students. These include the boy trade scholars, who are learning to be professional carvers, and women fee-paying students, some taking the full course, and others devoting only part of their time to carving The older art scholars of military age have naturally not had their scholarships renewed, and rather fewer evening classes are being held this session than usual. Of the boys who have recently completed their time in the school, several are in the army, and others are doing work for which their training has helped to fit them. One hardly expects woodcarving to be in demand at present, and a good many carvers have turned their attention to army work more or less connected with their craft, such as pontoon-making and covering cases to hold shells. On the other hand, some shops have work to do, and orders are still being executed for America. Woodcarving is not usually looked upon as an export, but of recent years some of the best English work has been commissioned for the States, and it is satisfactory to note that the war has not put an end to the trade, more especially as in days to come the United States will, presumably, have more money to spend than we shall. It will, of course, be found when things return more or less to their normal course that the war has dislocated the trade, but, as far as it is possible to judge at present, the condition of affairs will be more satisfactory than might have been expected, and, while it cannot be anticipated that during the continuance of the European struggle there will be any large demand for woodcarvers, the trade gives promise of being able to hold its own.

Lace.—There are, perhaps, few industries that have been more affected by the war than lace-making. After years of steady work, the craft, which had for some time been in a languishing condition, had been revived in different parts of England and Ireland and was beginning to find itself established on a satisfactory basis. Honiton, Buckingham, and Limerick lace were being made in fairly large quantities, and various Italian and

Belgian laces were being copied to good purpose; in short the English handmade lace industry had made a place for itself. It is still keeping that place, but recent events have not tended to make its task easier. Handmade lace is a luxury, the best of it a very expensive luxury, and the demand for luxuries does not expand in war time. Further, the devastation of Belgium, a country in parts of which nearly every woman was more or less of a lace-maker, thoroughly upset the normal conditions of the market. At a moment when common humanity demanded that many Belgian lace-makers, both over here and in their own country, should be provided with work, London at any rate was flooded with Belgian lace hastily brought to this country out of reach of the invader—much of which was sold at a price ridiculously below its ordinary value to folks who had some sort of hazy notion that they were doing an act of charity in buying it. Now that the first rush is over, it seems time to consider the question of co-ordinating in some way the English and Belgian industries and making some effort to see that prices are maintained at such a level that lace-making will not become a sweated industry. The Anglo-Belgian Lace Hostel at 47, Upper Brook Street, founded by Mrs Inglefield under distinguished patronage, tries in some measure to do this. A number of Belgian lace-makers are housed on the spot, where they may be seen at work under thoroughly good conditions any afternoon between three and five o'clock, and their work, together with that of Belgian outworkers, married women and others with home ties, is on sale on the premises. There is a competent teacher at the hostel who has already been down to Buckinghamshire to teach the making of *valenciennes*. The stock at the depot includes also excellent cut work, the output of Miss Hill's industry at Taormina, and some Italian filet as well as a good collection of Buckingham lace, examples from the Folkestone industry, and some Essex needle-run. Apparently the English work is selling quite well and holding its own, but it is rather a pity that while the Belgian exhibits include not only the cheaper kinds of bobbin lace but also *point de gaze duchesse*, rose point and other sumptuous needle point, the finer kinds of English lace are not represented.

NOTES ON BOOKS.

RIVINGTON'S NOTES ON BUILDING CONSTRUCTION. Edited by W. Noble Twelvetrees. London: Longmans, Green & Co. In two parts. 7s. 6d. net each part.

"Rivington's Notes on Building Construction" were published originally in 1875, and since that time they have been a boon and a blessing to architects. Part I. has been revised on six occasions, but during the lapse of the last ten years or so building construction has developed in many directions. Reinforced concrete and steel-framed buildings, for instance, have come into great prominence, and new materials of many kinds have been introduced, so that, in order to bring the book up to date, it has been necessary entirely to rewrite it. The general editing has been entrusted to Mr. W. Noble Twelvetrees, who contributes a number of chapters, while the rest of the book is the work of well-known architects and others, with special knowledge of the subjects which they deal with.

The work is divided in two parts: The first is concerned with matters requiring attention before the commencement of building operations, and then with forms of construction by the aid of which buildings of different types can be carried up from foundation to roof level. Part II deals with roofs and classes of work which pertain to the finishing of buildings for occupation and subsequently with various branches of engineering. It will thus be seen that the book is a complete *vade mecum* for the architect, and the names of the contributors, which include some of the most distinguished members of the architectural profession, are a guarantee of the excellence of the various sections.

SALT IN CHESHIRE. By Albert F. Calvert, F.C.S. London: E. & F. N. Spon, Ltd. 21s. net.

Cheshire has been known as a salt-producing country for two thousand years, the first open pan having been erected there by the Romans, but in spite of this remarkably long and continuous history, no attempt has hitherto been made to present a consecutive and logical account of it. Salt-makers, according to the author, have always shown a strong aversion from publicity, and persons exhibiting a desire for information on such subjects as depth of shafts, results of borings, levels of brine, quantities of rock-salt won and brine pumped, have been regarded with suspicion and disfavour. No little credit, then, must be accorded to Mr. Calvert, who, in spite of these difficulties, has succeeded in collecting from all manner of sources an extraordinary amount of information dealing with the many aspects of the subject. His book runs to between 1,100 and 1,200 pages. After a preliminary chapter on the chemistry of salt, he gives in great detail the early history of the Cheshire salt industry, illustrated by a number of quotations from contemporary documents. Special chapters are devoted to theories of the formation of the Cheshire salt deposits, the area of the beds, the top rock mines, and the growth of the industry, while a very full account is given of its later development.

Not the least interesting section of the book is that devoted to the Cheshire subsidences. Mr. Calvert's first reference to this alarming phenomenon is dated 1533, when "a pease of a hill having trees on hit" sank, and a pit containing salt water was formed. From that date the subsidences have become more and more frequent, and a large

number of photographs illustrate very vividly their extensive and dangerous nature. In some cases houses are seen sinking below the level of the street, or inclining at all sorts of extraordinary angles; in other cases large tracts of agricultural land are shown converted into briny marshes; while in others, again, whole streets are being raised to keep them above the water level. The damage done by these subsidences has been enormous, and the legal questions arising therefrom have been numerous and keenly contested. Bills dealing with the right of land owners to pump, and of house owners to compensation, have been many, and into all these the author goes very thoroughly.

If the Cheshire salt industry has had to wait many years for its historian, it has not waited in vain; for Mr. Calvert has been daunted by no difficulties in securing and presenting the fullest information, and his work may fairly be described as monumental.

WIRELESS TIME SIGNALS. London: E. & F. N. Spon, Ltd. 3s. 6d. net.

This is a translation of the French official handbook, "Réception des Signaux Radiotélégraphiques par la Tour Eiffel," which has proved of great value to navigators, geodesians, explorers, and horologists. A very clear account is given of the wireless apparatus, ordinary and scientific time signals, and the methods of calculating comparisons by means of the scientific time signals. The original French version is so well known and appreciated that the English translation may be sure of a welcome. The translators add some useful appendices on weather reports and international signals

GENERAL NOTES.

SCHOOL OF ART WOODCARVING.—At the School of Art Woodcarving, 39, Thurloe Place, South Kensington, some of the free studentships in the evening classes, maintained by means of funds granted to the school by the London County Council, are vacant. The day classes of the school are held from 9 to 1 and 2 to 5 on five days of the week, and from 9 to 1 on Saturdays. The evening class meets on two evenings a week. Forms of application for the free studentships and any further particulars relating to the school may be obtained from the Secretary.

NATIONAL COMPETITION, EXAMINATIONS IN ART, AND AWARDS IN ART, 1916.—In view of the urgent need for national economy and other circumstances arising out of the war, the Board of Education will not hold a National Competition in 1916. They hope to hold the examinations in art as usual, and have issued regulations for 1916 accordingly. They desire, however, to give notice that it may prove necessary at a later date to suspend the examinations. The interim regulations for scholarships, exhibitions, free studentships, and other awards in art applicable to the year 1914 are provisionally continued in force subject to certain modifications. Notice is also given that at some future date after the conclusion of the war one further special examination will be held for the benefit of candidates who had almost completed the requirements for the Art Class Teacher's Certificate and the Art Master's Certificate when the old regulations expired. The detailed arrangements will be announced in due course, and at least three months' notice will be given of the special examination.

NEW ZINC FACTORY FOR JAPAN.—The zinc industry of Japan is still in its infancy, there being only two factories—the Amagasaki Zinc Factory and the Mitsui Bussan Kaisha Zinc Refinery. Since the outbreak of war the imports of zinc into Japan from Germany and Belgium have been totally suspended. Naturally, the price of the metal, which ruled at £24 per ton before the war, has risen steadily, and now rules at over £40 per ton. In Siberia there are large zinc mines, the output of which has hitherto been forwarded to Germany and Belgium. With the opening of hostilities the supply of zinc ore to Europe became impossible, and prices fell considerably. Taking advantage of this, says the *Japan Gazette*, the Mitsui Bussan Kaisha recently entered into an arrangement with owners of zinc mines for supplies. It is stated that a big zinc factory will be established in Japan in the near future, under the auspices of merchants interested, with a view to meeting the demands on the domestic market.

MEMORIAL TABLETS. THE FIRST ENGLISH THEATRE.—The first building erected in London specially for the performance of plays was known as "The Theatre." Its site had not hitherto been determined with precision upon satisfactory evidence, but a detailed investigation was undertaken under the auspices of the London County Council, and a booklet containing an account of the inquiry has just been published. The building was erected by James Burbage, a leading member of the Earl of Leicester's players, in 1576. The most meticulous care has been taken to verify the site, which was on a plot of ground bounded on the west by Curtain Road, on the south by New Inn Yard, and the east by New Inn Broadway, Shoreditch. The Theatre existed for twenty-two years. Among the pieces acted there was Marlowe's "Faustus." It is not clear that any of Shakespeare's plays were ever performed in the Theatre, though there seems reason to believe that Shakespeare himself, as a member of the Lord Chamberlain's company, often acted there. The Theatre fell into disrepute, and after a series of quarrels it was pulled down in 1598, when the materials were carried away to the south side of the Thames and used in the construction of the Globe. It is probable that after the war a memorial tablet will be affixed to the wall of the Curtain Road School, Shoreditch, commemorating the fact that the Theatre once stood within a few yards of the spot.

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PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

FOODSTUFFS.

By David Sommerville, B.A., M.Sc., M.D.,
Assistant Professor of Hygiene and Public Health, King's College, London

Lecture IV.—Delivered May 17th, 1915.

With some of the above considerations in mind we may retrace our steps and look again at the structure, the molecular structure of the cell, the unit of bioplasm. This complex may be regarded as a machine in which there is a constant flux of energy. In it absorption, transformations and redistribution of energy proceed unceasingly, whilst structural changes in its life history march but slowly.

In order that oxidation of the various food-stuffs contributed by the environment may proceed freely, it is essential that the integrity of the cell be preserved by the proper adjustment of all the necessary organic and inorganic constituents. The inorganic constituents are as important as the organic. When inorganic ions are altered so that the running equilibrium between protoplasm and ion is destroyed cell activities cease. Ringer demonstrated, in the case of the muscle of the frog's heart, the indispensability of the inorganic ions. Function can only continue in the presence of the proper osmotic concentration of the saline solution perfused; but the osmotic concentration is not the only condition; there are definite limits to the amounts of the individual ions essential to the continued existence of the cell. An isotonic solution of NaCl may wash out of the cardiac muscle potassium and calcium ions to such a degree that, although sufficient oxidisable organic material be present for the liberation of the necessary energy, the whole architectural fabric of the cell falls to pieces. It has been shown that the quantities of potassium and calcium required are exceedingly small (KCl 1 in 10,000), and that the working range of concentration in either direction is exceedingly small, otherwise the heart ceases to beat.

In the cold-blooded animal the oxygen tension of the atmosphere is sufficient to maintain for a lengthy period cardiac activity if adjustment of the inorganic ions be correct. In the case of the mammal the oxygen tension must be raised to nearly that of an atmosphere of pure O by passing O through the warmed saline solution used. This increased O pressure supplies the place of the red blood corpuscles.

What we have learnt from the reactions of cells leads to the conception that the intermixture of proteins, carbohydrates, fats, and inorganic ions forms a system but lightly held together, each component kept in position by the pressure of a free part in the fluid which bathes the cell, an inexorable condition being that the osmotic pressure of each constituent lies within the narrow range proper to it. It would appear that in this labile equilibrium of varying intensities of attachment amongst the constituents, proteins, fats and carbohydrates undergo molecular disruption, that oxygen unites with them, and when the pressure of the oxidised products reaches a certain height these bodies pass away from the cell. The perpetuation of such labile equilibrium appears to be a necessity to life. In the protein molecule, largely constructed of amino-acids, we have an ideal combination for the attainment of this end. The amino-acid contains both a basic and an acidic radical "two opposite poles, as Moore puts it"—whereby an attraction is set up between different molecules. On union of two such molecules the new molecule of double size, or double size less a molecule of H_2O, possesses also two free and opposite poles; so that under favourable conditions a repetition of the chemical union described may proceed and that without limit, save the stability of the chemical system, until an equilibrium between the anabolic or synthesising and catabolic or disrupting forces is attained. Change the

environment of the cell and the limiting conditions change. There are all possible gradations in the degree of such unions: it has become customary to speak of the feebler unions as adsorptions. In the state of present knowledge it is impossible to say whether certain unions are physical or chemical—it may one day appear that there is no fundamental difference between the two types of union. The fact remains that certain unions are only stable so long as a certain concentration or pressure is maintained, and break up as the pressure diminishes.

The cells of the body are rich in potassium and phosphatic ions and poor in sodium and chlorides. The fluids, on the other hand, are rich in sodium and chlorides and poor in potassium and phosphatic ions. It would appear, therefore, that the tissue cells have special chemical affinities for potassium and phosphatic ions, and no such affinities for sodium and chlorine. The proteins of the fluids apparently possess the opposite affinities. The view is held to-day that the chief factors determining equilibrium between ion and cell are concentration of ion and the affinity (adsorptive or chemical) between the ion and the cell. This affinity changes its value from one ion to another in the same cell, and from one cell to another with the same ion.

That ions are in a loose type of union with proteins is evident when we consider that depression of the freezing-point in blood serum is almost the same as in water containing an equal amount of salts; the same remarks pertain to the electrical conductivity in the two cases.

It was formerly thought that if there were sufficient quantities of proteins, carbohydrates and fats in the diet, health was ensured. With lapse of time, quality of food as well as quantity attracted attention.

We now know that the quality factor is all-important. We have seen that proteins deficient in aromatic amino-acids, such as tyrosine and tryptophane, fail as nutritives. No excess of other amino-acids will meet this deficiency.

With some knowledge of the properties of internal secretions, hormones, and enzymes of various types, we are prepared to accept the view that the presence or absence of the merest trace of an active biochemical substance may be the cause of effects profoundly beneficial or disastrous.

Attention has been focused in recent years on certain conditions described as deficiency diseases: Beri-beri, pellagra, scurvy, rickets, etc. It has long been known that the Tamils in the Malay Peninsula who consume unpolished rice do not suffer from beri-beri. Other races who suffer from the disease use their rice in such ways that it is not clear whether the disease is wholly due to the lack of the polishings. Considerable experimental work has been done on animals, especially birds, with a view to clearing up the position. Pigeons and chickens fed on polished rice become victims of the disease. The same birds fed on unpolished rice escape. If taken in time, the disease may be stopped by adding to the diet of unpolished grain the polishings or a chemical preparation of the polishings. Funk has attempted to recover chemically the substance or substances (named by him, vitamines) which prevent the neuritic condition in animals; but, so far, no definite body has been isolated. A large number of substances generally employed as foodstuffs are said to contain vitamines, *e.g.*, extracts of yeast, wheat, barley, oats, maize, beans, milk, cabbage, wholemeal bread, bran, etc. Such bodies are said to be soluble in alcohol and water, to be able to pass through a semi-permeable membrane, and to be destroyed at a temperature of 100°. It has been thought that they correspond with certain pyrimidine compounds, and some one has ventured the opinion that they are identical with allantoine or one of its derivatives.

Abderhalden and Lampe found that boiling the rice—thereby presumably weakening or killing the toxin—diminished its power to produce polyneuritis, but did not prevent it altogether.

In pellagra, cure can often be effected by replacing the maize by other cereals.

In scurvy, cure is rapidly produced by the administration of lemon juice, green fresh vegetables, etc. An exclusive diet of bread produces scurvy in guinea pigs, rabbits, dogs and pigs (Holst and Frolich). Heat and long keeping are said to decompose the antiscorbutic substance. Many antineuritic foods, such as yeasts, barley, oats, etc., contain no anti-scurvy vitamine.

Rickets is now known not to be due to lack of fat nor lime salts. Hopkins' experiments on young rats (*Jour. Physiol.* XLIV. 1912) points to something of the nature of vitamine in minimal quantities of fresh milk which can prevent scurvy. Osborne and Mendel have located a growth-vitamine in the fat of milk, and have demonstrated the failure of lard to promote growth in the same manner as other natural fats do (butter fat, egg yolk, cod-liver

oil, etc.). This failure is shown not to be attributable to deteriorating changes arising from heat or chemical agents in the manufacture of the product. They show that heating butter fat with steam does not destroy its growth-promoting efficiency. Beef fat is more efficient in promoting growth than lard. When butter fat and beef fat are fractionally crystallised from alcohol, the growth-promoting factor remains in the mother liquor or "oil" fractions. The fractions containing fats with high melting-points are ineffective.

A recent paper by W. L. Braddon and E. A. Cooper shows that chickens fed on one-twentieth their body weight daily of parboiled unpolished rice, or fresh partly polished rice, remain free from polyneuritis for twenty-eight to one hundred days. Chickens fed on the same ration of polished Siam rice develop symptoms of polyneuritis in twenty to seventy days.

When polished rice is soaked in excess of water for twenty-four hours, the birds succumb to polyneuritis in from ten to thirty-five days; when the rice is soaked for forty-eight hours the disease appears still more readily, viz., in fifteen days.

Chickens fed on one-twentieth their body weight of parboiled rice, which had been soaked for twenty-four hours, also develop polyneuritis in from thirteen to thirty-nine days. This fact is regarded as of practical importance, since epidemics of beri-beri have been traced to the practice of soaking unpolished rice prior to cooking and discarding the water.

Although birds fed on diets of polished rice, sago, or glucose, develop polyneuritis, when fed on commercial starch they fail to do so, and merely lose considerably in weight. While fowls fed on one-twentieth their body weight of parboiled unpolished rice remain free from polyneuritis for at least sixty to one hundred days, when this ration is supplemented by one-sixth the body weight of washed unpolished rice, they develop polyneuritis in about the same time--ten to twenty days.

On dietaries composed of rations of polished rice, varying from one-twentieth to one-fortieth the body weight, and of yeast varying from $\frac{1}{2500}$ to $\frac{1}{3500}$ the body weight, pigeons and chickens do not develop polyneuritis until at least thirty-two to one hundred days have elapsed; but when the carbohydrate ration is doubled by the addition of polished rice or sago the birds fall ill in from thirteen to forty-six days.

When daily rations of polished rice as large as one-tenth the body weight are fed to chickens, together with varying amounts of yeast, 93 to 98 per cent. of the carbohydrate is digested and absorbed, and the excreta contain no anti-neuritic substance. This shows that the rapid development of polyneuritis induced by feeding large rations of starch is not due to interference of undigested carbohydrate with the absorption of the active material. Intestinal bacteria, unlike yeast, contain little anti-neuritic substance. These observers conclude that the amount of anti-neuritic substance required by the organism increases with the quantity of carbohydrate metabolised. For the maintenance of health the intake of active substance must, therefore, be adjusted so as to stand in some quantitative relation to the ration of carbohydrate ingested, and it is when this necessary balance is not maintained in the dietary that beri-beri results. Although as ordinarily induced beri-beri can be described not inaccurately as a deficiency disease, it may thus actually develop when a dietary containing an adequate amount of the anti-neuritic substance is regularly supplemented by a ration of a carbohydrate foodstuff deficient in this essential substance. Attention must therefore be paid to the proportion which the anti-neuritic foodstuff bears to the total carbohydrate ration. Large rations of those foodstuffs deficient in the essential substance should be avoided. In a dietary intended to prevent beri-beri, it is necessary to consider both the content of the anti-neuritic material and the total calorific value.

Sperry and Rettger having thoroughly purified the proteins, egg albumin, serum albumin, and edestin, demonstrated that the following bacteria, aerobes and facultative anaerobes, viz., B. subtilis, B. anthracis, B. pyocyaneus, B. prodigiosus, B. proteus vulgaris, B. coli communis, B. typhosus, and S. pyogenes aureus, are unable to attack these native proteins in the pure state. They extended their research to three anaerobes, viz., B. putrificus, B. anthracis symptomatici, and B. oedematis maligni, and found the action of these to be also negative. Solutions of native proteins may undergo complete proteolysis, if they contain peptone or other nitrogenous food material, which readily furnishes the nitrogen necessary for bacterial development. In such cases the proteolysis of the native protein is the immediate result of the action of an enzyme, which has been elaborated by the bacteria during the process of rapid multiplication. This

multiplication is made possible by the N-containing material present along with the native protein. The molecule of the native protein apparently must be split by a cleavage agent, such as an enzyme, acids or alkalies, heat, etc., before the bacteria can utilise it.

It is impossible to avoid the entrance of bacteria into the digestive tract. The normal flora of the alimentary tract, the obligate bacteria as they are sometimes called, *e.g.*, B. lactis aerogenes, B. coli, B. bifidus, have adapted themselves to the secretions, and by virtue of their adaptation, hold their own against new-comers. The common foodstuffs are liable to contain injurious bacteria, such as pyogenic cocci, typhoid, paratyphoid, and dysentery bacilli, B. proteus vulgaris, and the sporing anaerobes B. putrificus, B. aerogenes capsulatus, and B. botulinus. The proteolytic action of pepsin and trypsin in healthy individuals acts as an effective check to the growth of most varieties of bacteria.

The members of the B. lactis aerogenes group are morphologically little different from those of the B. coli group. Greater differences exist in their biochemical characters. They form gas on sugar media more readily, coagulate milk more rapidly, produce gas from potato starch, and fail more frequently to manufacture indole. Their fermentative powers are greater than those of B. coli, whilst their putrefactive powers are less.

Few living bacteria of the B. coli group are present in the fæces of healthy persons with obstinate constipation. Certain bacteria have the power of checking the growth of B. coli. Streptococci from human fæces repress the growth of B. coli in the anaerobic limb of the fermentation tube.

B. coli exerts an inhibitory action on the putrefactive anaerobes, so also does the B. bifidus group. The presence in the colon of immense numbers of obligate bacteria of the B. coli type may be an important defence against putrefactive decomposition.

If one places some fæcal matter from a healthy breast-fed infant in a closed test tube in an incubator, the original not disagreeable odour lasts for days or weeks. Indeed, it is possible to inoculate such material with B. putrificus in quantity and obtain no evidence of putrefaction. The stools of such a normal infant exert an intense inhibitory action against various bacteria. The inhibitory substances to which the restraining effect is attributed appear to be less active in the stools of nurslings than in those of adults.

If mixed fæcal flora be grown in sugar broth, and in sugar broth containing $CaCO_3$, for a week at 37°, it will be found that a considerable quantity of volatile fatty acids has been formed in each case. The quantity will be considerably greater in the carbonate flask. The molecular weights of the acids found in the carbonate broth are higher than those of the acids in the sugar broth. This suggests a greater activity of putrefactive bacteria in the neutral medium, for such tend to form the higher rather than the lower fatty acids. A neutral medium favours the development of putrefactive bacteria, especially of the anaerobes; an acid medium restrains the growth of putrefactive bacteria and encourages the growth of lactic acid producers. In the neutral flasks some of the lactic acid is probably transformed into butyric acid. The influence of milk containing lactic-acid formers in controlling putrefactive decompositions in the digestive tract finds its explanation in the inhibitory action exerted by these bacteria and by the lactic acid already formed. The chemical character of the food, the solubility of the food in the digestive juices, the quantity and composition of these digestive juices, all affect in important ways the ultimate fate of the food in its relation to bacterial decomposition; and intimately connected with these factors is the influence of aerobic and anaerobic conditions of the tube.

By the careful application of Gram's stain, it is possible to divide all the bacteria found at a given level of the bowel into two groups—those which retain the stain, Gram-positive, and those which do not retain the stain and are hence susceptible to colouration by a counter stain, Gram-negative. This difference of behaviour is due to biochemical differences in the bacteria. If this method of examination be supplemented by making aerobic and anaerobic cultures on plates of various media, one obtains a fairly accurate idea of the representative bacteria of the tract.

Suspensions of fæcal material in the proportion of one part by weight to ten parts of normal saline solution are prepared and used to make smears on microscopic slides. When dry and fixed, the smears are stained by Gram's solution for a period of about three minutes. The solution is run off the slide, not washed off, and Lugol's iodine solution is applied for two minutes. The slide is then rinsed with water and decolorised for half a minute with absolute alcohol. Lastly the smear is counterstained with a dilute fuchsin solution. The same technique must always be applied, otherwise confusing results are obtained.

A smear thus prepared from a healthy breast-fed infant's fæcal matter presents a characteristic field. The bulk of the bacteria are Gram-positive, and present the appearance of a nearly pure culture of one type. The organisms are slender bacilli slightly curved and of moderate size; they are the B. bifidus of Tissier. This organism dominates the field. Perhaps there are a few large plump bacilli occurring singly or in pairs, the B. aerogenes capsulatus, and a small number of Gram-positive diplococci growing in chains. The principal remaining Gram-negative bacteria are the B. lactis aerogenes and B. coli.

In the case of infants fed on cow's milk, the picture is different; the number of bacteria is considerably greater. The dominant organisms are of the B. coli type. The field, in other words, is as a whole Gram negative instead of Gram-positive. In adults the number of putrefactive anaerobes is larger. The presence of B. aerogenes capsulatus can be determined by anaerobic plating in blood agar. B. putrificus may also be present. B. coli is well represented.

In old age the putrefactive organisms are still more abundant.

The intestines of carnivorous animals contain many more putrefactive organisms than those of the herbivorous. Inoculations in bouillon flasks produce sulphuretted hydrogen and methyl mercaptan. Colonies on anaerobic plates show that a large portion of the organisms are B. aerogenes capsulatus. A generous use of meat in the human subject over a long period of time encourages the development of much larger numbers of spore-bearing anaerobes than would be the case if a different type of protein were substituted for meat.

It is known that the fresh tissues of animals reduce methylene blue; and the reducing action of fresh liver has been utilised in the anaerobic arm of the fermentation tube. Meat that has been but slightly cooked retains a considerable portion of its reducing power. These facts have their application in the alkaline fermentation found in the lower bowel of large meat eaters.

Prompt absorption of food, more especially protein food, is one of the most important factors in preventing the occurrence of excessive putrefactive conditions in the alimentary canal. The presence of large quantities of partially-digested proteins in the anaerobic region of the gut facilitates putrefactive fermentation. Those measures which are designed to secure prompt digestion and prompt absorption limit to the greatest degree putrefactive decomposition.

Since different types of bacteria possess their own special forms of foodstuffs, and disappear when the foodstuffs necessary for existence disappear, it is quite possible, by changing as radically as circumstances will allow the entire dietary at times, largely to compel the disappearance of certain organisms. The treatment of putrefactive fermentations on these lines has been successful.

From the Gram stain one learns something of the number of colon bacilli, of the state of their preservation, of the number of Gram-positive diplococci, of the presence of B. bifidus, and of the number of sporing anaerobes. Further, the method is useful in studying the sediments in fermentation tubes inoculated with mixed fæcal flora. In tubes inoculated from normal persons Gram negative organisms, corresponding in size and form to B. coli, grow abundantly in all the tubes. These are accompanied by Gram-positive and Gram-negative diplococci in moderate numbers, and by very moderate numbers of B. aerogenes capsulatus.

In cases of excessive intestinal putrefaction B. putrificus is found in abundance in bouillon flasks neutralised by $CaCO_3$. Such flasks may contain H_2S, methyl mercaptan, ammonia, volatile fatty acids, indole, phenol, and skatole. If methyl mercaptan is shaken with isatin-sulphuric acid the red changes to deep green.

Two molecules of indole unite with one molecule of β-naphtha-quinone-sodium-mono-sulphonate in the presence of a small quantity of alkali to produce a blue or greenish blue colour. A concentrated solution of indole will give a precipitate. By this means indole can be removed from a mixture of indole and skatole. The last can be distilled and recognised by the blue colour produced with Ehrlich's aldehyde, dimethyl-amido-benzaldehyde.

Bienstock's B. putrificus is a spore-bearing strict anaerobe, giving rise to characteristic products of putrefaction, including butyric acid and hydrogen. It forms H_2S and methyl mercaptan, but not indole.

B. aerogenes capsulatus is a strict anaerobe difficultly spore-bearing, gas-forming, and Gram-positive. The gas consists of CO_2 and H. This organism contains hæmolysing and proteoclastic enzymes, and forms butyric acid.

Propionic, butyric, and higher volatile fatty acids are common products of putrefaction. They are formed by putrefactive anaerobes, not only from protein media, but also from sugar-containing media.

During putrefaction ammonia and other bases

appear. Phenols, cresols, skatole, and indole may all be found in the same putrefactive digest, and in the faeces of patients suffering from intestinal putrefaction. Herter showed that the hepatic and renal cells and the epithelial cells of the intestinal tract can absorb considerable quantities of indole and phenol, tying them loosely so that they cannot be recovered by distillation. This action, he held, served as a screen to the nervous system. Their presence, even in slight concentration in the blood, induces violent nervous excitation followed by depression. Where the intestinal and liver cells are damaged, and the screen accordingly destroyed, the worst symptoms of autointoxication appear. Free indole circulating in the blood induces severe muscular fatigue.

Intestinal indicanuria is an evidence of intestinal putrefaction. It is easily produced in dogs by feeding excessive quantities of meat.

In certain cases of indicanuria of high degree ferric sulphate has been beneficially administered as a catalyser, inasmuch as small quantities of this salt render some oxidations of organic matter much more efficient.

When certain individuals of middle age or over consume excessive quantities of proteins—*i.e.*, larger quantities than they can assimilate and finally oxidise—a more or less definite set of symptoms appears, characterised by headache, drowsiness, lassitude, and irritability. Such symptoms are accompanied by abnormal physical and chemical changes in the urine, by physical, chemical, and bacteriological changes in the fæces, and by increased arterial tension The urine of such a patient is more toxic to animals than normal urine; its surface tension is lowered; it contains increased quantities of indole, indole-acetic acid, phenol, skatole, and aromatic oxyacids—all products of intestinal putrefaction. The ratio of ethereal to preformed sulphates is increased. The ratio of ethereal sulphates to total nitrogen is increased. It is known that chlorides, phosphates, sulphates, etc., raise the surface tension of urine, that other bodies, such as urea, sugar, and albumin, act indifferently; whilst aromatic compounds and certain fatty acids depress it. The curve of surface tension runs parallel with the curve of aromatic constituents. The quantity of urine is variable; frequently it is less than normal. The specific gravity is variable; not infrequently it is less than normal. The fæces may be solid and dry or diarrhœic, or alternate between constipation and diarrhœa. The odour may be highly offensive. Undigested proteins, fats, and carbohydrates are present in varying quantities. A carefully prepared 10 per cent. suspension in normal saline examined microscopically by Gram's method yields a field in which the dominant organisms are B. aerogenes capsulatus and B. putrificus; whereas a corresponding preparation from the fæces of a patient of the same age in perfect health furnishes a field in which the dominant organism is B. coli. The chemical reaction is alkaline. Phenols may be recovered from the liver of such a patient should he die suddenly by accident. Is there a causal relationship between the phenols of the fæces of this patient and his clinical condition? I think there is.

It will be objected that the evidence deduced from experiments on animals is not sufficient to show that the indoles and other aromatic bodies are toxic. It will be further objected that individuals can be found who excrete large quantities of indoles and other aromatic bodies conjugated with sulphuric and glycuronic acids, and yet have no toxic symptoms. These individuals, I reply, completely oxidise their phenols. That the phenols and other aromatic bodies mentioned are produced by the hydrolysis of proteins by anaerobic bacteria must be admitted. These products do not occur in the fæces or urine of the healthy breast-fed infant, whose alimentary tract is free from putrefactive anaerobes. They occur only in small quantities in the healthy adult. In adults in whom they occur in larger quantities, and who suffer from toxic symptoms, they can be greatly lessened and made to disappear by substituting carbohydrates for proteins in the diet. The toxic symptoms decrease and disappear at the same time. In this, as in all other problems of metabolism, the most important matter for consideration is not what happens in the alimentary canal, nor what bodies are found in the urine, but what is constantly happening in the body tissues—blood, liver, cord, brain, etc. This patient suffers because he is unable to oxidise sufficiently the aromatic bodies formed in his large bowel by the action of anaerobic bacteria on proteins. Perhaps the epithelial cells of his intestinal mucosa are damaged and fail in their antitoxic action; or, being damaged, they let through more toxic material than the other portions of the oxidising machinery (hepatic cells, cells of the thyroid, suprarenals, etc.) can deal with. Or it may be that other parts of the oxidising machinery are at fault.

The statement that dogs and monkeys have been injected with indoles and phenols and have

failed to show any symptoms of toxaemia in no way militates against the other statement that such products damage certain men. The oxidising powers of the dogs for these substances are greater than those of the men. The dogs can deal efficiently with the toxins, hence no toxaemia. The quantity of aromatic bodies in the fæces furnishes no information concerning the work that is being done by the oxidising machinery. The latter can only be measured imperfectly by the aromatic sulphates and salts of glycuronic acid in the urine. On substitution of carbohydrates for proteins in the diet of such cases the ethereal sulphates gradually diminish. That they do not fall suddenly in many cases points to the conclusion that oxidation goes on in the tissues after putrefaction has ceased in the gut. Such inability on the part of the oxidising machinery to keep pace with the formation of putrefactive products is a definite indication for the reduction of protein in the diet. In the treatment of this form of auto-intoxication animal proteins may be discarded entirely for a time as they yield larger quantities of phenols than vegetable proteins.

It will be clear that the resolution of problems of this kind, as indeed most problems in practical medicine, can only be satisfactorily effected by a balanced combination of clinical and laboratory research. And perhaps it will be one day admitted that the widest and soundest knowledge of such natural phenomena can be obtained only by those who cultivate both fields of research.

WINTER OATS.*

While endeavouring to increase the area under wheat, farmers should arrange, if possible, not to reduce the area under oats, for, to a nation at war, this grain may be just as useful as wheat, and the straw is of special value as fodder for stock. In many districts, particularly in the south of England, repeated attacks by frit-fly (sometimes called "bottling") have rendered spring oats a precarious crop. Winter-sown oats, however, are less liable to attack by this pest, and might, therefore, receive increased attention at the present time. They are also better adapted than spring oats for land badly infested with charlock.

Varieties of Winter Oats.

Two varieties are commonly grown, namely, Winter Grey or Dun Oat, and Winter Black Oat. In deciding which to grow farmers should be guided largely by local experience, for while both may grow equally well in any particular district, there is sometimes a keener local demand by merchants for one than for the other. The black variety possesses somewhat stronger straw than the grey, and might generally be given the preference on land subject to "lodging." It is more liable to shed its seed than the grey variety, and should be cut before it is dead ripe. In neither case is the straw so palatable as that of the finer spring varieties, but when chaffed and mixed with cake and meal it is readily eaten by stock.

* Special leaflet issued by the Board of Agriculture and Fisheries.

Soil and Cultivation

Winter oats are suited to a wide range of soils. They can be grown successfully on soils too light or too poor for wheat, and they prevent such soils from "washing" in a wet winter. Further, they can be taken as a second corn crop, provided the land is clean. They are not so hardy as winter wheat or winter barley, and consequently must be sown earlier, preferably in September, so that the plants may become well established before cold weather sets in. The ground should be left somewhat rough as a protection against cold winds; and with this object in view it is customary in some districts not to harrow after drilling.

Unless the land is thoroughly clean, weeds, favoured by a longer growing period than usual, may seriously reduce the crop.

About three to four bushels per acre should be sown; the earlier the sowing and the cleaner the land the less the quantity of seed necessary.

Winter oats often contain seeds of a Brome Grass (*Bromus secalinus*), a troublesome weed on light land; purchasers should see that seed oats have been carefully cleaned.

Winter oats are best suited to the warmer southern counties, and are generally ready for cutting from ten days to a fortnight before other corn crops. This enables the land to be prepared sooner for the following crop, a point of some importance when farming is conducted at high pressure. On the other hand, the earlier ripening is a disadvantage near towns where birds are numerous.

SILK AND SILKWORM INDUSTRY IN CHINA.

The China number of the *Manchester Guardian* contains an interesting account of the Chinese silkworm industry.

Hatching and Feeding

The cocoons selected for the following year's breeding are suspended and threaded through the loose web with string and hung in a dark place, where the worm, which has formed itself into a chrysalis, lives during its confinement; then, as a moth, in about eighteen days it bites its way out of the cocoon. The moths are then placed on sheets of brown paper about eight inches square and allowed to pair off, and after about four hours they are separated, the females remaining on the paper (covered over with a rice basin). In

about twenty-four hours four moths will lay between five and six hundred eggs, the eggs adhering to the papers. These papers are sold at 20 cents a sheet or stored in boxes until next breeding season (20 cents are equal to *5d.*). The cocoons which the moths have left are called pearced. The loose web which is taken off the cocoon before spinning is called strippings. Both are refuse silk and are exported to Europe, made up into various articles, such as silk and cotton rugs, etc., reimported into China, and exported to other countries. In the month of April the hatching season begins, and if the first brood is strong and healthy two crops will be obtained in one season.

The first process is done by the native women placing the sheets of paper on their breasts next to the skin, and keeping them there day and night until the silkworms begin to hatch out as little dark objects. The papers are then placed on cotton wool in order to retain the heat from the body, and the silkworms are fed on finely chopped mulberry leaves. Then they are allowed to rest and not fed until a movement is seen; then fed again, and then given another rest. This is repeated several times. The worms grow very quickly, and when strong enough are removed to round bamboo trays and fed, the whole mulberry leaves being placed lightly on top of them. They are then fed every four hours night and day, and occasionally changed to clean trays.

Stripping and Spinning.

In about four weeks they have grown wonderfully, and if proper care has been taken of them they are ready to spin, which is noted by their throwing their heads up and refusing to eat, the threads of silk being now seen between their feet. They are then removed to rice straw on round trays, on which they wander until they find a suitable place to spin the cocoon. If kept a little in the dark during all stages they will work quickly and thrive much better. In a few days they will all have enclosed themselves in cocoons. It is very pretty to see the straw all covered with these egg-shaped silk balls, yellow and white intermixed. When they have all spun and the cocoons are hard to the touch they are taken from the straw. The loose web is stripped off the cocoon, placed on round trays and dried in the sun for a few hours, and taken to the spinning-wheel, a crude affair consisting of a wooden wheel on two uprights. Another stand holds an earthenware charcoal shatty and an iron pan (like that in which the natives boil their rice) in a wooden upright. There is also a contrivance with three arms. Between the two upper ones is a bamboo roller; the lower arm bears a copper cash. Fresh water is placed in the pan and kept up to nearly boiling-point, about twenty cocoons are placed in the hot water, and, with the assistance of a pair of chopsticks, the threads are picked up together, passed through the square hole in the copper cash, once round the bamboo roller, and over to the spinning-wheel. Each cocoon gives off one thread of silk; so many of these are brought together in the spinning, and every bit of silk is wound off each, leaving the chrysalis bare.

The natives do not like to destroy the moths on the premises after breeding for fear of spoiling their hopes of a good crop next year; so small boats are made from bamboo leaves in which they are placed and floated down the stream. Now the silk all spun, in its two natural colours, yellow and white, is taken to the dyeworks and then to the hand-loom, which is another cumbersome wooden structure taking up the space of no less than 20 ft. by 6 ft. by 9 ft. Each machine is worked by a man and a boy, various lengths and widths are made, figured, plain, or raised velvet figured, according to requirements; it is all hand work, and one machine will make from one and a half to two yards a day. Many of the owners of these looms sell the silk off the loom either by native measure or by weight.

Mulberry Culture.

The mulberry tree is cultivated in this part of the country, not for the fruit, but for feeding the silkworm, and miles of these trees can be seen in perfect lines well looked after.

TRADE AND COMMERCE OF BENGASI FOR 1913.

Bengasi, on the Tripoli coast, was occupied by the Italians on October 20th, 1911, and although a new era was thereby introduced in the history of the country, the protracted resistance of the Beduin tribes which has thereon ensued has hindered the development expected. Trade with the hinterland has been checked, capital has held aloof, settlers are not attracted, and even the most necessary public works are proceeding slowly. In spite of an exceptionally plentiful rainfall, only a small quantity of grain has been realised; the crop in the more distant parts of the province has been gathered by the Beduins. For two years after the occupation the military operations prevented any sowing, and the exportation of grain is still prohibited. The imports of wool and butter have fallen off considerably, and the trade in ivory and ostrich feathers from Wadai has, for the present, ceased entirely. In spite, however, of these discouraging circumstances, the imports into Bengasi have already recovered the level of former years, and appear to be steadily increasing; and in flour, meal, vegetables, groceries, wine, beer, hardware, soap, and coal the increase has been very considerable. Although the information is as yet only roughly classified, there is enough to show that Italy has now a very strong position in the trade of this port, while other countries remain a long way behind. The principal cause of the growth of Italian trade here is the presence of the army of occupation, and of a large and increasing element in the town population.

Regular steamship services, and direct postal and telegraphic communication with Italy, the presence of branches of the Bank of Italy and of the Bank of Rome, all help to consolidate Italian influence and commercial supremacy in the district. The only regular lines are the Italian, Sicilia and Servizi Marittimi, the Hungarian Adria, and the German Levant Line. No British ship called in 1914, and in 1913 only two put in, one of them bringing a cargo of coal for the railway.

Plans for the construction of a harbour, large and deep enough for the accommodation of steamers that now have to lie out in the open roadstead, have been prepared by the public works department of the Italian Government. It is proposed that a shallow place, enclosed by a reef facing the town, should be filled in and converted into quays. Beyond the reef, where there is a depth of 46 ft., two piers or breakwaters would be built to form a spacious basin. The cost is estimated at thirty million lire, or £1,200,000, and the work would take about eight years to complete. A Decanville railway interconnects the forts outside the town and runs out a few miles to Benina, this being probably the first step towards the ultimate connection which will be established with Egypt by rail.

One great drawback to the development of the country is the scarcity of water. A good rainfall, such as that of 1913, means abundance, while the bad years, which unfortunately are more frequent, may bring the inhabitants to the verge of starvation. The necessary works have not yet been completed. Water is still brought into the town in small barrels carried by diminutive donkeys, though water-carts are also beginning to be used. Additional wells have been sunk, pumps and tanks have been erected, and pipes have since been laid to carry the water to the town. The dust, the glare, the swarms of flies, and the usual Oriental neglect of rational hygiene cause a distressingly high percentage of blindness and ophthalmia, while coloured goggles and glasses are extensively used by both Europeans and natives.

THE FORESTS OF FRANCE.

As regards the extent of her forests, France occupies the sixth place amongst the countries of Europe, following, in order of importance, Russia, Sweden, Austria-Hungary, Finland, and Germany. The forests of France cover an area of 886,701 hectares (3,423 square miles).

In proportion to its size the Department of the Landes contains the largest area of forest, the greater part of which is due to the replanting of the uncultivated lands, and now occupies more than half, or 55·4 per cent., of its total surface. The woods in the Departments of the Var cover 49·5 per cent., and in the Gironde 46·2 per cent. The smallest proportions of forest lands are in the Departments of Finisterre, 4·4 per cent.; Seine, 8·7 per cent.; and the Manche, only 3·2 per cent. The mountainous regions are less wooded than is popularly supposed, Savoie, 22·4 per cent.; Haute Savoie, 28·4 per cent.; and the Vosges, 36·9 per cent., in all of which Departments it is very desirable that the example set in the Landes in the replanting of forest trees should be followed.

The largest forest in France is that of Orleans, which covers an area of 30,000 hectares (116 square miles). The forest of Fontainebleau, probably the most beautiful in France, has an area of between 15,000 and 17,000 hectares (about 58 to 65 square miles). Its picturesque glades, alleys, and gorges are much frequented by artists and lovers of forest scenery during the summer.

Amongst others famous for their beauty may be noted those of Pontarlier, Eu, and especially the forest of Tronçais in the Department of Allier, which covers an area of 10,000 hectares (38 square miles). The forests of the Ardennes and Compiègne are noted for the chase.

The timber grown in these forests is principally oak, birch, pine, beech, elm, and the Spanish chestnut, whilst the cork tree flourishes in the south of France, especially in the Department of the Var.

VETERINARY WORK IN INDIA.

Considerable progress has recently been made by the Provincial Veterinary Departments of India in educating the people to believe in the scientific treatment of animal diseases. The numbers of cases treated in hospitals and dispensaries, and by officers on tour, are steadily increasing, and in one province, the Punjab, many private individuals have come forward to establish veterinary hospitals at their own expense, while in the Central Provinces some of the cattle-owners voluntarily deposited the cost of 500 doses of anti-rinderpest serum. At first there was strong prejudice against inoculation, but, according to the Report on the Progress of Agriculture in India for 1913-14, cattle-owners are beginning to look upon it with great favour, and consider it the only satisfactory measure to be adopted against rinderpest. Striking instances of the efficacy of the anti-rinderpest serum were demonstrated at Gaisabad and Chanda in the Central Provinces, where 7,233 cattle were inoculated with no mortality amongst them.

In some of the provinces rinderpest was more widespread than in previous years, and there would have been a great increase in the number of animals inoculated but for an unfortunate breakdown in the supply of serum from Muktesar. Large orders for the serum were received from Egypt, the Sudan, and Rhodesia, which had to be set aside; but new centrifuges have been installed at the Imperial Bacteriological Laboratory at Muktesar, and a branch laboratory at Bareilly is being expanded, by which it is hoped that it will be possible to meet the growing demand for serum.

Special endeavours have been made to improve

the sheep industry in the Punjab. Breeding experiments, undertaken in the United Provinces with a view to ascertain how far the fleece of the indigenous sheep can be improved, have so far yielded satisfactory results. The introduction of a merino cross has produced a very beneficial effect on both the quality and quantity of the fleece. Similar experiments have also been conducted at Pusa.

A good deal of useful research work has also been carried out at the Muktesar laboratory and also by individual officers of the provincial departments in connection with rinderpest, surra, anthrax, kumri, and bursati. The Imperial pathological entomologist at Pusa has continued his investigations on the bionomics of flies likely to be surra carriers, on the habits and life-history of lice, and on the egg-laying reactions of blood-sucking *muscidæ*.

CORRESPONDENCE.

NON-POROUS ALUNDUM FOR PROTECTING SHEATHS OF PYROMETERS.

In the course of my paper on "Recent Progress in Pyrometry," read before the Society on May 12th last, the following passage occurs (*Journal* of May 14th, 1915, pp. 593 and 594).—

"Several new materials have been introduced to form the protecting sheaths necessary to shield junctions from the corrosive action of furnace gases. Alundum (oxide of aluminium) is now used for this purpose; but, although it possesses a high melting-point (2050° C.), it is too permeable to gases, particularly at high temperatures, to be of general service."

Since the paper was written I have been informed by Messrs. Townson and Mercer, the British agents for alundum, that a non-porous variety can now be obtained, suitable for pyrometer sheaths, etc., the refractory qualities being equal to those possessed by the ordinary kind. Experiments with various gases show that the new material is not permeable even at temperatures exceeding 1400° C., and hence forms an efficient shield for pyrometer wires or materials which would be deleteriously affected by furnace gases.

CHAS. R. DARLING.

GENERAL NOTES.

ENGINEERING CONGRESS AT SAN FRANCISCO.—An international engineering congress was held last week at San Francisco. A large number of the papers read dealt with various engineering aspects of the Panama Canal, and the congress was appropriately presided over by Colonel Goethals. Among the British contributors were Sir Albert Stanley, who presented a paper on "London Traffic in 1913"; Mr. Alfred Dryland, county surveyor of Surrey, on "The Construction and Maintenance of Rural Highways"—a subject which was also dealt with by Mr. Arthur Gladwell, surveyor to the Eton Rural District Council. A short paper on "Public Utilities" was contributed by Mr. Edward Willis, of Chiswick; whilst "Testing of Materials" formed the subject of a paper by Mr. R. G. Batson, of the National Physical Laboratory. A Sheffield engineer, Mr. A. J. Capron, dealt with "Recent Progress and Present Status of the Art of Forging, with special reference to the Use of Quick-acting Forging Presses." In the electrical engineering section there were two contributions by English authors—one by Dr. H. F. Marshall, of London, on "The Economics of Electric Power Station Design," and the other on "The Production of High Permeability in Iron," by Professor Ernest Wilson, of the University of London, King's College.

"THE ENGLISHWOMAN" EXHIBITION OF ARTS AND HANDICRAFTS.—This exhibition will be held at the Central Hall, Westminster, from November 17th to 27th. There will be exhibits of hand-weaving, jewellery, pewter, leatherwork, book-binding, pottery, sculpture, stained glass, enamelled glass, woodcarving, inlaid furniture, Chinese lacquer, antiques, artistic dress, handmade flowers, embroidery, lace, baskets, dressed dolls, toys, illumination and caligraphy, illustrations, colour printing, etching, water colours, miniatures, photography, gardening, lingerie, children's and ladies' frocks, smocks, etc. Owing to the war, workers in arts and handicrafts have received very little support from their usual clients during the year, and depend largely for their opportunity of sales upon such exhibitions as the one to be held at the Central Hall. Further particulars may be obtained on application to the Secretary, *The Englishwoman*, 11, Haymarket. S.W.

PROPOSED WAR EXHIBITION AT LIÉGE.—It is proposed by "L'Oeuvre des Artistes," an Art Society of Liége, to organise a great war exhibition, as soon as the liberation of Belgium is effected. The exhibits will include, among other things, pictures, engravings, lithographs, and war posters.

CHADWICK LECTURES.—The third programme of War Lectures, under the Chadwick Trust, will be given as follows: Professor D. Noel Paton will lecture on "Food in Wartime," at the Hampstead Central Library, on October 4th, 11th and 18th, at 8.15 p.m; Dr. R. O. Moon will lecture on "Typhus in Serbia," at the Royal Society of Medicine, on October 20th and 29th, and November 3rd, at 5.15 p.m.; Mr. A. Saxon Snell will lecture on "Emergency Military Hospital Construction," at the Royal Institute of British Architects, on November 10th, at 8.15 p.m.; and Mr. W. E. Riley on "Some Conclusions on Housing our Workers," at the Royal Sanitary Institute, on November 17th, at 8.15 p.m.

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FRIDAY, OCTOBER 8, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

MUNITIONS INVENTIONS DEPARTMENT.

The Secretary of the Royal Society of Arts has received the following communication from the Comptroller of Munitions Inventions:

Princes Street.
Westminster, S.W.
October 4th, 1915.

The Secretary, Royal Society of Arts.

SIR.—Permit me, through you, to draw the attention of the members of your Society to the fact that the Munitions Inventions Department, which, you will remember, was recently constituted by the Minister of Munitions for the purpose of dealing with ideas, suggestions, and inventions for appliances in connection with the prosecution of warfare on land, has been authorised by him to receive projects of this nature on any matters appertaining thereto.

An advisory panel of scientific and other experts, appointed by the Minister, is assisting the Department in the task of dealing with the large number of inventions that have been, and are being, received, every one of which is given consideration by the panel. This body is glad to consider also suggestions with regard to simplification and improvements either in the manufacture or in the materials of existing munitions, or, indeed, in any other respect.

I should be glad if you would make known as widely as possible to your members our existence and functions.

I am, Sir,
Your obedient servant.
E. W. MOIR,
Comptroller of Munitions Inventions.

CANTOR LECTURES.

The Cantor Lectures on "Oils, their Production and Manufacture," by F. Mollwo Perkin, Ph.D., F.I.C., F.C.S., M.Inst.P.T., have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Royal Society of Arts, John Street, Adelphi, London W.C.

ORGANISATION.*

This, I venture to think, is by far the most important question of any I have raised, and I will go so far as to say that I believe it to be the all-important one, as it practically embraces the others. If you do not agree with me, I feel sure it is because we do not understand the same thing by the word "organisation." When you speak of organisation to most people they immediately seize upon some small feature which may be to them of more immediate interest. It may be the general arrangement of their accounts, their system of store-keeping, of dealing with their work men, of the sales department, or fifty other minor details. If you take this narrow view of organisation you will, of course, at once say that a scientific man has very little to do with it, and indeed the manufacturer as a rule, thinking of his works organisation, scouts the idea that a man of science can either know or have anything to say about it which is of any value.

Let me therefore take the dictionary definition. To organise is to "arrange or constitute interdependent parts, each having a special function, act, office, or relation with respect to the whole." If we accept this definition, which as a matter of fact we must, there is no question as to the all-important nature of organisation, for you will notice there are two outstanding things The first, "interdependent parts"; and the second, their "relation to the whole." Thus the subject of organisation really includes the whole of industry. It includes science and its relation to manufacture.

* Extract from the address to the Engineering Section of the British Association at Manchester by H. S. Hele-Shaw D.Sc., LL.D., F.R.S., M.Inst.C.E., President of the Section

It includes the relations between the employer and employee. It includes the workman and his attitude towards new devices, labour-saving appliances, and output. It includes the whole question of the supply of raw materials, and even the sale and delivery of the finished article. Taking these different features, is there any doubt that the man of science in this country can hold his own, and more than hold his own, with that of any other? The history of invention is quite enough to give a final answer to this question. Again, the British employer and man of affairs has always shown himself individually in the forefront of enterprise; as for the workman himself, he is admitted, in the matter of intelligence, physical endurance, and skill, to have no superior; while with regard to materials for manufacture, and the power of delivering goods, it need scarcely be said that the British Empire, if we take it as a whole, is the richest country in the world in raw materials, and its means of delivery of its goods is expressed by the enormous preponderance of its mercantile marine.

When we come, however, to these interdependent parts and their relation to the whole, it is there that we find the weak joint in the armour. It is in this respect that Germany can teach us a striking lesson in the *arrangement* of these interdependent parts with respect to the whole. From the top to the bottom the whole forces of their industries are so thoroughly organised that they get all that is humanly possible out of the various factors. I do not limit this merely to the wonderful organisation of any works, like Krupps, or the Deutsche Maschinenfabrik, or hundreds of other works, but I include the organisation of all the Government departments, together with the banks, the railways, and the shipping, so that every facility is afforded for the world commerce of the German Empire.

Taking only one of these details, I remember, when at Liverpool, and the battle of the Manchester Ship Canal was being fought, what facts came out as to the difficulties in the transhipment and handling of goods. The late Mr. Alfred Holt, for instance, was one of the most earnest in pointing out that the want of co-operation and organisation in getting goods from our manufacturing centres was adding largely to their cost, and actually exceeded the cost of transporting these goods across the ocean. In Germany, on the other hand, the Government steps in, and by means of special differential rates gives the manufacturer every facility, and the lowest possible rates for obtaining raw material and delivering the finished goods to all parts of the world. It was this organisation that not only rendered Germany so formidable a rival in times of peace, but makes her so powerful in war.

This co-ordination in Germany is carried out in every industry in a way we generally have little idea of. For instance, the other day, at a deputation to the Government, Mr. Runciman remarked that the difficulty of connecting the manufacturers with the commercial staffs in this country is deep-seated, but perhaps not altogether incurable. Further, that the manufacturer must realise what he can get from the universities, and the university must know what the works require. Dr. Foster, the treasurer of the Chemical Society, also said that "the Germans were so imbued with the need of pursuing modern and efficient methods of education, in applying science to industry, that they hold in contempt a country which notoriously neglects such processes"; and he attributed this contempt as partly contributory to their cheerfulness in entering into the war with us.

Now, while these remarks are undoubtedly true, they are only a part of the truth. The evil is far wider than in any special application, for, as the German knows perfectly well, there are innumerable individual cases of organisation in this country of equal efficiency to any in his country, and he is glad enough to learn from special cases. Let us take one, and I do so because it shows that the man of science is capable of industrial and manufacturing organisation, if he turns his mind to it. I refer to the case of the firm known as Barr and Stroud, Ltd. As you know, the founders of this firm were originally colleagues in the Yorkshire College (the former, Professor Barr, occupied the Presidential chair of this section three years ago), and they together invented a range-finder. Now, whatever the merit of this range-finder, it is safe to say, like every other important invention—for instance, the Parsons turbine—that the invention alone would have stood a small chance of coming into practice. In fact, to make the invention is, as a rule, the beginning of the difficulty. Professors Barr and Stroud, however, set to work to carry their invention into practice, and did so with such effect that their works, which began on quite a small scale, rapidly grew, and the first part of the new works was opened with about ninety hands all told in 1904. In the course of ten years it has increased to such an extent that there are now 1,700 employees. Those of us who have visited the works at Glasgow know the almost perfect way in which the whole arrangements are made, not merely for the scientific side, but for the comforts of the men, including the working dress, which in itself becomes a uniform. It gives some idea of the scientific side to know that it includes at the present moment twenty-three men with high university qualifications, most of them with university degrees, and many of them men who were absolutely the first on the college list in the final examinations. This industry is another illustration of the lead given to Germany by this country, because the Barr and Stroud range-finders were brought out before any of the German range-finders of the kind now being made, the Germans having followed in their lines, and copied them in many respects. I have enlarged upon this, because I cannot help pointing out that the Barr and Stroud range-finders have had no small effect in the

marvellous precision of our naval guns, and it will no doubt pass through your minds what we owe to private enterprise which started the manufactures of the turbines, range-finders, guns, and other naval features, when we think of such battles as those off Heligoland or the Falkland Islands.

Now I do not believe the Germans despise us for our want *per se* of the application of science to industry. I do not think they have much reason to; but what they do despise us for is the want of co-ordination, which I venture to say amounts to positive slackness, which they are keen enough to observe permeating the whole of this country. They see different sections, instead of being united for a common end, quarrelling with each other, filled with mutual suspicion and distrust, with apparently no common bond of union, and whereas the German is proud of the Fatherland, he sees in this country large numbers who seem, either through self-consciousness or ignorance, to be ashamed to mention the subject of the British Empire, or, what is worse, to acknowledge that any love of their country is, or could be, a mainspring and incentive to strenuous effort.

The other day Field-Marshal von Moltke stated, and there is no reason to disbelieve him, that great as was the storage of ammunition and shells before the war, the enormous demand far exceeded all expectation, and Germany found herself for a time in the same plight as her enemies; but he further stated that Germany's emergence "from this dangerous position was largely due to the extraordinary organisation, which included not merely the adaptation of their factories for munition purposes, but *capacity for work of the people*, and the *patriotic spirit of the German workmen*."

This brings me to consider what is probably the most serious feature in our national life to-day, which I have already alluded to under the heading of Education, viz., the relation of employer and workman. It is hopeless, as long as such ideas prevail as seem to do at present, to think of any sound organisation of our industrial system taking place, because the interdependent parts are not arranged (and can never be arranged until we change radically) with respect to the whole. Now, as one who has served an apprenticeship, who has taken his money weekly from a tin box with hundreds of other men, who has been a member of the Amalgamated Society of Engineers (in fact, was working as an engine-fitter when a Whitworth scholarship made a college career possible), I am the last man to put this evil down entirely to the working man. I know individually he is just as capable of patriotism as any other class. Get him by himself, even the men whose strikes have caused such despondency in the minds of our Allies, and who have seriously jeopardised the very existence of the country, and you will find (except in the sort of case to be found in all classes of society), that he, as an individual, is willing to make sacrifices, and if necessary to give himself for his country. The truth is that the canker which is eating the heart out of our industrial life is due to an entirely wrong attitude of mind. For instance, however much we may sympathise with men who see a loss of employment in the introduction of labour-saving machines, some means should be found by which they can share the benefits to the State and to their employers by the introduction of such machines. I should like, if I had time, to say something about the marvellous organisation of the Ford motor-car works in America, and how it has given the men a share in the returns of a great industry, and thereby induced them to work in a way that has enriched themselves, their employers, and their country. We have many splendid examples of this co-operation in this country. For instance, Messrs. Allen, of Bedford. Again, the employment of women in the engineering industries has taken place in many directions owing to the war. The works with which I am associated could not have undertaken much munition work without it. Some steps should be devised by which this avenue of industry is not closed to women after the war, while justice is secured for the men alongside of whom they are working, and from whom they are in many instances learning mechanical skill. Again, the questions of piecework and overtime must be seriously considered by the State, and not allowed to become the subject of disastrous disputes. Once more there is the question of a standard wage. It is against the eternal laws of nature to try to keep living beings at one dead level of equality and merit—*i.e.*, it is against the law of the survival of the fittest. The trade unions have a great opportunity of placing their country and themselves in a leading position amongst nations if they will courageously grapple with a great problem by recognising degrees of merit and corresponding degrees of payment. These are a few of the many matters which must be dealt with in the immediate future.

The matter of labour disputes is so serious as to demand plain speaking. It must be admitted that there are many employers and companies which, to satisfy themselves and their shareholders, extort the largest possible dividends and pay the smallest possible rate of wages, and do so apparently without the slightest idea that the men and boys under them are capable of education and personal influence. Can it be wondered, then, that men under these conditions are willing enough to listen to the orator who merely appeals to their fighting instincts and join in the game of grab as against the employer? On the other hand, strikes have occurred when employers have honourably carried out their obligations and undertakings, and the men have shamefully departed from an agreement made by their chosen leaders, throwing over the leaders the moment they have fancied it to their own selfish interests to do so, and without a single thought of their duty to the community as a whole.

We have recently seen the Prime Minister and other leading statesmen struggling, sometimes in vain, to bring large bodies of men to a reasonable state of mind. Is not this (and I speak without

the slightest reference to party questions) a case of Nemesis overtaking us for having in so many cases pandered to the selfish instincts of large bodies of men in order to secure their votes, instead of sternly telling them unpalatable truths?

There was recently an intensely interesting article by the late Professor Friedrich Paulson, previously Professor of Philosophy in Berlin University, published in the *Educational Review* of New York. In this article, the subject of which was "Old and New-fashioned Notions about Education," he pointed out that the whole of our educational system was going wrong, and that we could not escape the conviction that a tendency towards weakness and effeminacy was its chief trait. His three mottoes were: Learn to obey; learn to apply yourself; learn to repress and overcome desires; and he remarked with great truth under the first heading: "He who has not learned to do this in childhood will have great difficulty in learning it in later life; he will rarely get beyond the deplorable and unhappy state that vacillates between outward submission and uproarious rebellion."

Is not one of the first things the reform of our educational system?

The other day a writer in the *Spectator* said with great truth that "what Great Britain is suffering from acutely and dangerously at the present time is the absence of discipline," and a neutral writer in the *Times* remarked as follows: "The uniformity of German effort, due doubtless to their myriad well-organised, machine-like minds, though it renders them excessively tiresome people to dwell among in peace time, enables their Government to extract every ounce of energy in the conduct of a war." He further went on to say that the British Empire "could not have been created by minds like these, but it should not be forgotten that in the concentration necessary to national effort in a struggle like this the German system of self-subservience to the State has enormous advantages."

One of the tasks to which the British Association might bend its energies with the greatest benefit to the country is to bring about a reform of our educational system, so that while we do not kill individual enterprise and freedom of thought, which have contributed so largely to the political organisation and constitution of the British Empire, of the value of which we have had such wonderful evidence from our colonies and dependencies during this war, we seek to implant in the minds of young and old those ideas of discipline and service to the State, the want of which so seriously threatens the successful organisation of our industrial life.

RUSSIA'S POWER RESOURCES.

The *Engineering Magazine* draws attention to an article in the *Revue générale des Sciences* which discusses the extensive waterfalls and peat deposits that await exploitation in Russia.

Without considering the Caucasus, the Trans-Caspian region, or eastern Siberia, there are still in Russia proper great sources of hydraulic energy. In the northwest are the falls and rapids of various rivers—for example, the Volkhov with 30,000 to 50,000 horse-power, the Msta with 30,000, the Narova with 40,000 to 70,000, the eastern Duna 120,000, and the Niemen. In the north, again, the Olonetz region offers a number of available power sites, as do the rivers which flow into the Arctic. In the Ural Mountains energy could be obtained from lakes and from the rivers Chausovaya and Bielaia, and on the Valdai plateau are sites for power development. In the south and southwest are the falls of the Dnieper, 120,000 to 200,000 horse-power, and the rapids of Dniester and the central Bug.

Most of the sources of power, except in the case of the extreme northern streams, are found in regions thickly settled and already possessing considerable industrial development. Other sources, like the Duna Falls, are on important waterways, and in the case of the falls in the Olonetz region the rivers communicate with centres of power consumption.

Most of these power sites could be easily developed, and current could be supplied over long distances at a low rate. Hydraulic-power development would be intimately connected with the improvement of the rivers for navigation and with irrigation.

At present little of this potential power is utilised, except, of course, in Finland. Of the large possibilities, only the Narva Falls are exploited, and these in poor fashion. The capacity of the other twenty or thirty plants rarely runs over a few hundred horse-power, and the bulk of the Russian plants are small affairs of a few horse-power, supplying little factories, sawmills, etc.; there are also many primitive installations for village mills and similar purposes. A census of existing plants, finished by the Imperial Russian Technical Society in 1913, showed a total developed horse-power in the Empire of 250,000, of which the small plants furnished 80 per cent.

Development is, however, increasing, and better plants are being erected. Thus the importation of turbines climbs steadily, and the annual output of Russian turbines increased from 2,000 horse-power in 1900 to 7,000 in recent years. Large central stations remain extremely rare, but the series of Government undertakings, the requests for concessions and the large Stuart project in the Caucasus are encouraging signs. Legislation obstructing the erection of transmission lines needs to be altered, and especially there must be overcome great national ignorance as to the possibilities in electrical-power development, and the lack of knowledge even among technical Russians of the engineering and economic conditions governing hydro-electric installations.

Apart from hydraulic-power possibilities, Russia possesses a tremendous resource in the vast peat deposits underlying her many swamps. These

deposits constitute 7 per cent. of the total surface of the country, and are almost three times as great as the combined peat areas of Germany, Ireland, Sweden, and Finland. From the point of view of agriculture, peat deposits are classed as bad land. They tend to grow and encroach on farm lands, and for this reason, and to protect the public health, they have to be fought continuously.

From the fuel standpoint, however, these peat bogs are favourably situated, being, in general, distant from the oil and coal fields and relatively near the industrial centres. Many plants near bogs have used peat fuel for a long time. As the price of other fuels mounts, more and more peat is used; its extraction has taken on the dimensions of a large industry in many places, and involves the use of machinery. Especially in the Moscow-Vladimir district, where oil and coal are high, a good deal of investigating has been done, looking to the lowering of the cost of peat production and the use of distant deposits. The price of peat near power-plants is high, and the Government peat lands, when favourably situated, sell for good figures. The difficulty and cost of transportation are a stumbling-block in the way of extensive development.

The remedy for conditions is the construction, at large deposits, of central generating stations with long-distance transmission. The electric energy thus generated could be used also to cheapen the cost of extraction, electrical machinery for the purpose being more convenient and cheaper than steam.

The company which furnishes power to Moscow has undertaken a large project, involving the development of a peat deposit near the city of Bogorodsk. This plant will be built from the experience gained at a German plant in Friesland near Autrich, where a peat bog is being reclaimed; the peat incidentally excavated is used for power for the excavating machinery and for driving electric ploughs; the bog is to be consumed as fuel little by little; the conclusion will be the transformation of a waste area into tillable land. Another method of utilising peat when it is rich in nitrogen is to generate gas for internal-combustion engines, and make tar products, from which the fertiliser, bi-sulphate of ammonia, is extracted.

The potential importance of the Russian peat deposits for fuel can be expressed in figures. A ton of peat dried in the air to 22 or 25 per cent. moisture content has a calorific value equal to half a ton of Donetz coal, or 675 lb. of oil. Extraction, preparation, and air drying costs about $1.80 per dry ton, but this cost can be lowered by using the electric energy generated. The exploitation of the vast deposits tributary to the centre of Russia would lower the cost of fuel by a half, and the same in the northwest. The deposits belonging to the Government have been examined, and are found to run about 260,000 cubic feet per acre, equivalent to 2,300 tons air-dried. The area covered by peat deposits in Russia is about 177,000 square miles. If the same ratio holds over the country as for the Government lands, the total reserve is about 100,000 million tons of peat. This compares with coal reserves of about 80,000 million tons. The peat is constantly growing, and taking its heating value at half that of coal, it is evident that the peat reserves are about equal to those of coal. Around Petrograd half of the country is covered with peat bogs.

The exploitation of peat as a fuel requires a high degree of special knowledge. The many attempts in this direction in Russia have shown results deplorable from the technical point of view, although satisfactory financially. Continued experience will surely develop the most suitable methods, although adjustment to existing conditions may entail some expense. After the conclusion of the war, great progress in this work may be expected.

The possibility of long-distance electric transmission, as it has been developed in modern times, and the success of the scientific utilisation of peat, should open the way to the exploitation on an immense scale of the enormous deposits of peat which Russia possesses, and, along with this, the reclamation of worthless districts into agricultural lands.

AUTUMN AND WINTER FODDER.*

In view of the short crops of hay obtained in some parts of the country farmers may well be anxious to increase their stock of winter fodder. Considerable areas of aftermath will be saved for cutting, reducing the area available for late grazing, and it may be useful to consider especially in the event of a dry autumn, how a shortage of grass can be made good.

Maiden Seeds.

Sometimes a fair amount of autumn keep is furnished by "maiden seeds," but great care is necessary in the grazing of this crop if its future is not to be endangered. After the covering crop has been harvested the "seeds" should be rolled as soon as the implement is likely to make any impression on the ground. This will effect consolidation and promote tillering. Further, before being depastured the plants should be allowed to establish a firm and fairly deep root-hold as a precaution against winter frost, spring drought, and the risk of being up-rooted by stock. At the same time, if a short-lived plant, such as red clover, be allowed to reach or even approach maturity in its first autumn, the chances are that, by spring, much of it will have died. Grazing will check this and encourage branching of such grasses as may have been included in the "seeds" mixture.

Straw.

It is generally possible in winter feeding to replace hay either wholly or partially by straw.

* Special leaflet issued by the Board of Agriculture and Fisheries.

For this purpose the straws in common use are those of oats, barley and wheat. One of the chief functions of straw in a ration is to provide the bulk of fodder necessary to the health of a ruminant animal. The nutritive value of straw is usually low, but much depends on the degree of ripeness of the crop when harvested. The riper the straw becomes the greater is the transference to the seed of the most valuable nutritive matters, and the tougher it is to chew. In general, spring-sown cereals are less fibrous than winter-sown, and consequently more nutritious. Oat-straw is generally considered the most suitable for feeding, but barley straw, particularly if it contains a proportion of grass and clover plants, also forms useful fodder. Cereal straw is relatively rich in carbohydrates and uniformly poor in albuminoids, and consequently in feeding straw to stock the farmer has to arrange to increase the proportion of albuminoids in the ration. This can best be done by the addition of cakes or meals rich in albuminoids.

For feeding cattle, straw is chaffed and mixed with sliced or pulped roots, crushed cake or meal, and treacle water, and allowed to stand overnight. A slight fermentation sets up which softens the straw and further adds to the palatability of the mixture.

In order to save straw for fodder the extended use of bracken and peat-moss as litter is desirable.

Potato Tops.

The crops commonly used for supplementing bare pastures are vetches, maize, cabbages, early turnips and mangold leaves, but where a sufficiency of these is not available, potato tops may be found useful.

The tops should be cut soon after they begin, normally, to turn yellow, and be fed on grass land, but, as a precaution against the transmission of disease to future crops, should not be fed on grass which is to be broken up for potatoes in the following year. Green tops should be used very sparingly, preferably after being dried in the sun and wind. Tops bearing many blossoms or unripe fruits should be avoided, as they are likely to be unwholesome.

The tops should be collected as free from earth as possible, and be fed in small quantities along with other food.

White Mustard.

White mustard grows very rapidly and may be broadcasted upon stubbles broken up by the cultivator or disc harrow. Sown as late as the end of August, mustard will usually yield good food by the end of November. If not required for sheep feeding the crop may, with advantage, be ploughed in as green manure. From 14 lb. to 16 lb. of seed, together with 1½ cwt. of superphosphate per acre, should be sown.

Reeds.

Another plant not to be despised in times of shortage is the reed.

The common reed (*Arundo phragmites*), which grows luxuriantly in wet or marshy places, is mainly used, if at all, for thatch and bedding. The straw is too coarse and brittle to make really good litter, but is admirably adapted for thatch, and where available may well be used for this purpose instead of ordinary straw. For feeding purposes young reeds are suitable. The tops of the shoots are tender and succulent and are readily eaten by stock. As the plant matures, however, it becomes almost incapable of digestion, and unless specially treated would be quite unfit for food. During June and July the more tender portions of the plant may be dried and chaffed, and fed instead of straw. Later the greener portions may be converted into silage and thereby softened and rendered more palatable.

Care, however, should be taken to feed only small quantities along with roots and concentrated feeding stuffs.

Gorse or Furze.

Gorse or furze, which grows naturally on waste places, was used formerly in this country as food for stock, and was even specially cultivated for that purpose. Two types are commonly met with —the ordinary prickly gorse, and "French" or foxtail gorse, which is relatively free from spines. The latter requires less preparation for stock feeding and is, therefore, generally to be preferred, but ordinary gorse, once it has been thoroughly pulverised, may also be fed to stock with good results.

Gorse possesses the great advantage that it can be grown on poor thin soils where other plants would fail, and it will greatly improve such soils by its growth. Naturally, however, it thrives best on good well-drained soils: it will not do well on cold clays, or damp peaty soils, or on chalk.

Where foxtail gorse is specially grown for fodder the seed is drilled in rows 12 to 24 inches apart in April or May, on clean ground, at the rate of 12 lb. to 15 lb. per acre. Gorse seedlings are slow in growth, and it is most important, therefore, that weeds should be kept in check. The first cutting is usually made in the second winter after sowing, from November to the end of February. Thereafter the crop may be cut annually or biennially as found expedient.

In an experiment conducted on light sandy land at Woburn, "French" gorse yielded 11 tons per acre in its second winter.

Before being fed to stock, gorse is generally crushed between rollers, or otherwise pulverised. It should not be allowed to lie for long in bulk as it ferments and quickly becomes sour and unpalatable. In the case of old-established gorse only the green tops are fit for feeding. Old gorse covers, however, may be reclaimed by cutting down the woody plant as close to the ground as possible, and freely dividing the roots. Subsequent young growth will be available for cutting at one or two years' growth as may be required.

Gorse is a highly nutritious fodder, and has

proved satisfactory with all classes of farm live stock, more particularly with horses and milch cows. It should form, however, only part of the ration, as when fed in excess it proves too heating. This effect may be counteracted by giving occasionally a bran mash or a daily allowance of roots. Horses and cows may receive up to 20lb. per head daily. In the Woburn experiment already referred to, the gorse was put through a gorse-cutter and fed to sheep on swedes. In the fresh state the sheep ate, readily, up to 2½ lb. per head daily, and throve well upon it.

DRY-FARMING IN INDIA.

Experiments in dry-farming have been continued in India during the year 1913 14, and some account of them is to be found in the Report on the Progress of Agriculture in India for that period. Work was conducted by Mr. Howard at Quetta, where the conditions of water in the sub-soil resemble those in the best dry-farming areas in Western America, and where the rainfall is more or less consistently insignificant. By suitable methods of moisture conservation, it has been found possible to effect a great saving of irrigation water in Baluchistan. In the case of the wheat crop good results were obtained by giving only one watering before sowing (intead of the usual six to eight), and afterwards conserving the soil moisture by means of a surface mulch produced by lever harrows

The experiments in other places of moderate but uncertain rainfall relate to the evolution of standard farm practices which must vary according to local conditions Thus, in Mysore deep ploughing and use of the sub-surface packer for consolidating the land have been found to increase the yield of *ragi* (*Eleusine coracana*) in a season of scanty rainfall, while in the United Provinces hot-weather ploughing for wheat effects a saving of water when there is a great demand for it. The Departments of India already understand the general principles underlying dry-farming, and the matter is now largely one of development of improved practices by local demonstration.

In Bombay experiments have shown that in a year of moderate rainfall typical dry-farming methods are of distinct advantage in conserving moisture, but that in heavy black soil even the most careful cultivation will avail nothing in a "famine" year. Before studying further the question of dry-farming, it is considered necessary to classify the soils of the East Deccan where the rainfall is very light and to ascertain their physical properties, which make the problem in India different from that in the dry-farming regions of the United States.

In this connection the report quotes some observations of Mr. Keatinge, in which he speaks of the different conditions in the two places. "Another point," he says, "in which the dry-farming regions of the United States of America have an advantage over us is that the rainfall is far more consistent and better distributed. They know fairly well what rain they can count on, and do not get such excessive downpours in a day as we often get With us a tract which usually gets less than fifteen inches of rain in the year may suddenly get twenty inches in two months; or, contrariwise, in a famine year a tract may get less than two inches in a year. Further, the heat of the sun, and consequently evaporation, are far less in the United States of America during the greater part of the year; and in the late summer, when the heat there is considerable, the crops cover the ground. Last but not least must be mentioned the fact that they have at their disposal far better teams and far better implements than our farmers have."

SPANISH ORANGE TRADE AND INDUSTRY.

Official statistics, published in 1914, placed the value of the 1913 Spanish orange crop at 68,930,220 pesetas (£2,757,200), four-fifths of which represented the production of the Valencia district. But, figuring on a basis of 6,000,000 cases, the number exported from the Valencia region during that season, and an average value of 10 pesetas (8s.) a case, packed ready for shipment, this estimate appears to understate the real value for all of Spain by a considerable amount. Nevertheless, accepting it as true, the value given for this district, nearly £2,000,000, was considerably more than that of all the other crops of the district combined. As a yearly influx, this income is of supreme economic importance, being distributed among many large and small orchard owners, and thousands of male and female labourers, who derive a living from the orange industry seven months of the year. Judged by the cost and standard of living it is so large an amount that it cannot suffer heavy diminution without affecting the welfare and purchasing power of the district as a whole.

The steady increase in the production of oranges for several years is due to new plantings and to the progressive elimination of insect pests by the hydrocyanic-fumigation process. Markets also have been developed, but as they have not kept pace with the production, each year sees a larger prospective surplus, the possible ill-effects of which have not escaped the attention of the orange interests But fortunately, or unfortunately, according to the view-point, the apparent over-supply of each recent year has disappeared as a result of natural causes. The 1912 crop was destroyed by hailstorms before maturity to the extent of more than half a million cases, yet an ample supply of oranges remained to meet a strong demand in English and other European markets, and to produce the highest export figures ever known. The 1913 crop was one-third marketed in January, 1914, when the remainder was severely frost-bitten, leaving an actual shortage, which reacted so favourably on market conditions during

the balance of the season that the total value of the crop was higher than that of the preceding season.

The 1914 orange yield is said to have been the largest of all. An unofficial estimate, made just before its maturity, placed it at 8,000,000 cases (165 lbs. each) for export. Since orange statistics are not kept by official or commercial bodies, except by the volume of exports, this estimate cannot be verified, but it is thought to be conservative.

With the war as the only disturbing factor before the season opened, it was predicted that there would be a surplus of from 3,000,000 to 3,500,000 cases, but in the face of this man-made catastrophe the possibility of loss from sudden meteorological changes was overlooked. Therefore the district was little prepared for the heavy frost in February, which damaged about 1,500,000 cases, followed ten days later by cyclonic winds that further depleted the crop. The total loss is not known, but may reach 2,000,000 or more cases. Up to March 30th, 1915, nearly 3,500,000 cases had been exported by sea, and during the remaining weeks of the season the shipments were expected to reach 1,500,000 cases. Indications at the end of March were that the season's overland trade to France would reach 600,000 or 700,000 cases; hence there will be little, if any, of the anticipated surplus.

It appears from a report by the United States Consul at Valencia, that when the war broke out the orange interests of the district were greatly perturbed, and in numerous mass meetings held in all important centres the Government was urged to use its influence to find new markets in America, to regulate ocean freight rates by subsidising a steamship line between Bilbao and England, to normalise exchange facilities, and to compel improved railway service and cheaper rates in order to increase the domestic consumption of oranges.

A delegation of orange men went to the United States to investigate that market and to see if it was possible to inaugurate direct trade with that country, but it was soon discovered that competition with California and Florida fruit was not feasible. The Government met the demand for the tri-weekly steamship service from Bilbao to Falmouth, but the line was unsuccessful as a trade developer, and notice of discontinuance soon followed. The banks were unable to extend credit facilities on account of the moratoria in the United Kingdom and France; and bills of exchange were accepted, subject to payment of principal, only on receipt of telegraphic or mail advice of liquidation by the payer.

The movement to create a wider demand in Spain for Valencia oranges attracted more attention locally than any other proposal growing out of war conditions, but it produced no better result. Up to that time no interest had been shown in the domestic market, possibly because favourable conditions in foreign outlets served to distract attention therefrom; but more likely it was on account of the expensive and slow transportation service to urban centres, where the trade had to be developed. It was common knowledge, for example, that oranges could be shipped in less time and at cheaper rates by water from Valencia to Bilbao *viâ* England than by rail direct. Efforts were therefore made to secure important reductions in railway rates, and fast goods services to the leading Spanish cities. Unfortunately, the railways could not meet the demands in full, and the slight concessions granted were insufficient to encourage the movement. The reduced rates were based on mileage, the minimum being about 21s. per metric ton (2,204·6 lb.) for 500 kilometres (312·5 miles) or less; and the maximum 37s. per ton for 1,000 kilometres (621 miles) and above.

The 1914 orange season opened in October as usual, and at the end of the year the shipments to the United Kingdom, the Netherlands, and Scandinavian countries were above the average. From a monetary standpoint this preholiday period was highly successful for the shippers participating therein, but their number was small; the packers, as a class, could not take their customary places in the trade because the usual supply of English and German money was not forthcoming, and having no capital of their own they were without means to buy fruit and packing materials. Growers, therefore, had the choice of leaving oranges to spoil on the trees or of packing and shipping on their own account. Many at first preferred to do the former, but when the success of the first consignments became known pessimism gave way to speculation, and it was not long before the wharves of Valencia and other ports were crowded as never before with fruit awaiting exportation. Fortunately, much of it was held over because just at the time there was an acute scarcity of shipping.

Operations at the end of 1914 showed that the important German, Austrian, and Belgian markets were eliminated for the season, and overland shipments to France were about one-half normal. These losses were partially compensated by heavier shipments to the United Kingdom and the countries of northern Europe, and by new trade with Italy and America, leaving a net decrease of only 83,000 cases compared with the 1913 figures.

RESOURCES OF THE KAIHSIEN DISTRICT OF CHINA.

Kaihsien is a city of about 40,000 inhabitants, just north of Wanhsien, in the extreme eastern part of Szechwan Province. It is situated on a small but navigable tributary of the Yangtze River. The district under review is somewhat larger than the political division called the "Kaihsien district," and is bounded on the north by Chengkow, on the south by Wanhsien, on the west by Suiting, and on the east by Kweichowfu. This region contains

a population of 600,000 to 800,000, but the district is very sparsely settled.

The principal crops grown in the Kaihsien district are peas, beans, rice, maize, Irish and sweet potatoes, tobacco, cotton, millet, and sugar-cane. The chief winter crops are wheat, peas, beans, and Irish potatoes, while rice, maize, millet, sweet potatoes, sugar-cane, and tobacco are harvested in the late summer. A considerable quantity of wood oil is also produced. The hills in the northern section of the Kaihsien district have forests of oak, pine, and cypress.

A considerable amount of salt is produced in the Kaihsien district. The principal centre of this industry is Wen-tang-ching, eighteen miles north of Kaihsien, on the same river. The brine is found very close to the surface, and is mostly collected on the banks of the river during the season of low water. The coal found in this region is both cheap and abundant, and is used in evaporating the brine. It is brought down by river from Ma-chia-Kou, a small town four miles to the north of Wen tang-ching. The coal is not actually mined at this place, but is brought overland by coolies, a distance of nine miles, at a cost of about 2s. 11d. per ton. Iron ore is found in the Kaihsien district, as in most other parts of Szechwan Province. It is smelted in coal furnaces and is exported as pig iron to down-river points. Lime also is found, and limekilns are scattered throughout the hilly country in the northern section of the district. The rice fields are sometimes sprinkled with slaked lime to improve the quality of the soil.

Although the agricultural methods in use throughout the Kaihsien district are crude, there is not much prospect of selling agricultural machinery. The farms are small and the people comparatively poor. Considerable cloth weaving is carried on in the country districts, but it is done in a small way at a great many different centres. From a report by the United States Consul at Chungking it appears that there is not much chance of introducing textile machinery at the present time: but if factories are started and the industry develops to any extent there ought to be a market for cheap looms of simple construction. Mining machinery might even now be sold to advantage, both for coal and iron, and a modern smelter might be established very profitably at Ma-cha-kou or Wen-tang-ching. With the cheap labour above mentioned, and the extensive deposits of iron and coal, there is no reason why the Kaihsien district should not become, in the course of time, an important manufacturing and industrial centre.

THE DEVELOPMENT OF THE TEXTILE INDUSTRIES.

Coloured Cotton Fibre.—The prominence that has been obtained for reports of reputedly successful efforts to grow cotton in various colours is hardly of the most auspicious kind. Cotton has been grown in a limited number of more or less pronounced colours for, doubtless, thousands of years, and it is observable that such varieties have almost uniformly been considered less valuable than similar fibre in a good white. There can be no wish on any hand to disparage attempts to improve the coloration of raw cotton or to belittle systematic study of its culture. It trenches, however, upon the absurd to talk of presently substituting cultivated colours for dyed colours, and speculations based upon that prospect may be dismissed. There is no considerable difficulty in finding materials to dye cotton to as good shades as have hitherto been produced in the course of nature, and probably there will be no more in matching the tan, green, olive-green, and bronze colourings reported to have been grown lately in the United States. The opinion has been confidently expressed that the culture of a black cotton is not impossible, and the foundations of that belief need not be questioned. Whether there is actually much demand for the article is another affair. Black is presumably just black in the popular mind, but dyers who use and recognise some eight or ten separate shades of black are apt to find the description a little crude. In no case are the textile industries likely to run out of materials for black dyeing, for the sulphur blacks are fairly accessible and cheap, and as long as there is a supply of aniline oil a fast black can readily be developed upon the fibre. Upon the analogy of cottons at large the shade of naturally coloured fibre might be expected to vary between plant and plant if not between part and part of the same fibre and to vary also according to ripeness, to seasonal influences, and to the length of time in storage. Leaving all such considerations aside, there are practical difficulties in the way which far more than offset the superficial advantage of avoiding the dyeing process. White or whitish cotton can be mixed together in the loose, be worked in bulk and dyed to such shades as may be determined upon later. Necessarily, separately coloured loose cottons must be kept apart. The machines must be free of one colour before another can be put in, and adjoining machines cannot work upon differently coloured material for fear of contamination. Such inconveniences are not the only ones, but it is as well that their reality should be recognised. Perhaps the most that planters can do in practice is to provide a drab-coloured mass of fibre less handy for general purposes than the white that they might produce with less trouble. There is, of course, nothing new in utilising natural in place of dyed colours. The original khaki was the muddy colour of the brown cottons from which the fabric was made. In silk the brown of the tussor worm is sufficiently well known, and most knitted underwear is described as "natural." Not enough black and brown wool is grown to satisfy the demand for the nominally natural mixture shades, and the result is that art steps in to the aid of Nature. Nature in a general way cannot

better assist textile art than in furnishing materials that are easily reduced to a fair white, and that can be dyed to the shade which may be in vogue. The dyer's troubles are oftenest only aggravated by the existence of colour upon the material which he has to treat.

Osage Orange Wood.—A certain recklessness is observable in reports of the discovery of a new dyewood, osage orange, grown in Texas and Oklahama, and stated to furnish a yellow much in demand for textile work. Novelty can certainly not be claimed at this date for a dyestuff that is useful enough in its own way, albeit presenting a dye of less concentration than a better known wood of which there is no scarcity. Dyers in this country prefer fustic to osage orange, for the principal reason that they can obtain it more cheaply and certainly. Were fustic to fail them there are various vegetable sources within these islands yielding practically the same colour-principle; but apparently there is enough on hand to meet all possible requirements, with virtually unlimited quantities ready to be cut and shipped.

Budget Changes.—The new Budget proves to be of less specific moment to textile industry than at one time seemed probable, and with the removal of motor tyres from the list of articles liable to import duty the industry almost ceases to be directly concerned in the fiscal changes. Tyres are composed of strong cotton fabric as well as of rubber, and the manufacture of tyre cloths has risen to the dimensions of a quite considerable trade. The £15 millions or so of imported silks make a conspicuous mark for those searching for taxable imports, and it is not clear why this source was passed over. The odds and ends of cotton lace, trimmings, and embroidery imported into this country run normally into some £12 millions, and there are respects in which these may be coupled with silks as articles eligible to bear tax. In the matter of the increased cost of postages the textile manufacturing trade is almost disproportionately little concerned. There are doubtless manufacturing establishments with heavy bills for postage, but over a large part of the trade correspondence is remarkably light and brief. Bargains are made by word of mouth on the Exchanges—further negotiations concerning them are mainly verbal—accounts are collected frequently by hand, invoices are few and large in amount, and a visitor sees with surprise how mills both large and complex are managed with an insignificant clerical staff. The heaviest expenditure in postage is incurred by those shippers who forward myriads of patterns by post to customers oversea, and were the rise in inland rates of postage to be followed by an equivalent advance in foreign rates the addition to distributors' costs would become serious.

Machines and Hand Production.—The efforts of the Governor of Bengal to buy in India such Indian-made handkerchiefs as he had been wont to get in Edinburgh have attracted recent notice. Nobody discoverable in India knew where the articles could be bought, and inquiry had to be made in Scotland to ascertain their source. British manufacturers cannot be called anything less than well informed about the class of articles made by their own neighbours and competitors, yet such experiences as Lord Carmichael's are not unparalleled in this better-organised country. A case is known, for example, where reference had to be made to New York to learn the name of the producer of an article made in the next street to the English inquirer's address. The want of knowledge was by no means treated as a matter of course, even though it could be pleaded that the goods in point were not old ones. The incident of the handkerchief was used in Bengal to point some remarks upon the general desirability of fostering light, agreeable and artistic employments in which all the members of a household may take some part. The common fate of these domestic employments is to be devoured by factory production, and it is one of the less amiable features of modern industry that it has no scruple in breaking down idyllic occupations by the force of its machines. Native patterns are copied without remorse and put upon the market, if sales appear to warrant, at prices which leave the craftsman no chance. A process that has raged through the East, and been carried into Africa and elsewhere, has had its counterpart in this country. On the evidence of some surviving textile handicrafts in this country promoters of small industries cannot too earnestly be urged to seek directions in which it does not pay the owner of machinery to follow. Explicit advice upon the point can hardly be given, but it can be said that the presumptively largest colony of hand-loom weavers in England are people weaving bordered mats too small, in view of the number of changes involved, to be profitably woven upon power machines. The danger-point is reached by a small industry when it has built up a business of a certain size in goods of one distinct character. Probably it is beyond practical possibility so to diversify the products that their family character is lost, for in that case they are all too likely to lose their attraction for wearers. What is certain is that factory competition cannot be trusted not to break into any little sphere that skilled craftsmen may succeed in creating.

Mill Lighting.—In their recommendations the Departmental Committee upon the Lighting of Factories and Workshops confine themselves to matters affecting the illumination of floors, passages, and stairs, with a view specifically to the prevention of accidents. Their report goes a good way further and summarises measurements of the intensity of the light falling, not upon the floors, but upon the point of work in a number of

factories, textile and other. It will be found a most instructive handbook for those who have to do with illumination, natural or artificial, and one not unlikely to encourage manufacturers to think of having the lighting of their own rooms recorded. Citation of an instance or two will show what some ascertained differences in lighting have been, and it assists understanding to realise that in the regular saw-toothed, roof-lit weaving shed the normal daylight factor is some 2 per cent. of the light outdoors. In one large weaving-shed examined the mean daylight factor at the loom was 5 per cent., and in a small one was ·20 per cent. These data give the extremes, but it may be believed that smaller differences are material, and that it is better to have a mean of 3 than of 1·5 per cent. Some experiments made with seamstresses sewing coloured fabrics with self-coloured threads show that good illumination is especially requisite in treating coloured materials, and that in point of fact ten times more light may be needed for work on dark colours than on light ones. Artificial illumination is more under an occupier's control than daylight, but it is apparent that lighting is not uniformly good. In the best recorded instance the mean strength of light at the loom was 8·7 foot-candles, and in the worst case rather less than 1 foot-candle. Differences as great are recognised between several spinning rooms and carding rooms, and the tabulation of a variety of specimen cases cannot fail to stimulate interest in the subject.

NOTES ON BOOKS.

VICTORIA AND ALBERT MUSEUM.

(1) Catalogue of the Schreiber Collection of English Porcelain, Earthenware, Enamels, etc. Vol. I. -Porcelain. By Bernard Rackham. 2s. 6d.

(2) Guide to the Collection of Carpets. 1s.

(3) Catalogue of a Collection of Miniatures in Plumbago, etc., lent by Francis Wellesley, Esq., 1914-15. 6d

(4) Tapestries. Parts I. and II. 6d. each part.

The war would seem to have interfered but little with the activities of the Victoria and Albert Museum. We have before us a number of catalogues produced during the year; each of them is a well-printed and presentable volume; each is fully illustrated, and two of them, at least, must have involved a very considerable amount of research and labour on the part of their compilers.

The original catalogue of the Schreiber Collection was published in 1885. Since then a great advance has been made in the study of English pottery and kindred arts, and this has rendered necessary a considerable expansion and revision of the material. The new edition will consist of three volumes, of which the first deals with porcelain, while the second will deal with earthenware, stoneware etc., and the third with glass and enamels.

The Schreiber porcelain belongs for the most part to the eighteenth century, when the manufacture was established and reached its zenith in England. The catalogue contains interesting notes on the wares of Bow, Chelsea, Derby, Worcester, Longton Hall, Plymouth, Bristol, Liverpool, Staffordshire, Swinton, Lowestoft, Nantgarw, Coalport, and some short account of Chinese porcelain decorated in England, and of German (Meissen), Chinese, and French (Sèvres) ware. In addition to these general notes, the catalogue supplies a detailed description of each particular exhibit, while there are nearly 100 illustrations of the principal specimens.

The "Guide to the Collection of Carpets" gives a concise and informative description of the industry as carried on in Persia, Turkey, the Caucasus, Central Asia, China, Spain, North Africa, and England. Full justice is done to the work of the Royal Society of Arts in the eighteenth century in encouraging the making of carpets in this country. During the years 1757 to 1759 the sum of £150 was awarded to craftsmen engaged in carpet-making. Thomas Moore, of Moorfields, and Thomas Whitty, of Axminster, received premiums in 1757, and Whitty received further awards in the next two years. Passaver, of Exeter, and Jeffer, of Frome, also received premiums. There can be no doubt that the bestowal of these awards had a very considerable effect in encouraging the industry in its earliest stages, and it is recorded in the Society's *Transactions* (1783) that by these awards the manufacture of carpets "is now established in different parts of the kingdom, and brought to a degree of elegance and beauty which the Turkey carpets never attained."

The Guide is enriched by 47 full-page plates, which give as good an idea as can be conveyed in black and white of objects which owe their chief beauty to their delicate and harmonious colouring.

The miniatures described in the third catalogue under notice illustrate a few kinds of monochrome portraits executed chiefly in the seventeenth, eighteenth, and early nineteenth centuries. The illustrations include works by Loggan, Faithorne, George and Robert White, and Thomas Forster, who are generally considered the best exponents of the art. It is interesting to see that two of the miniatures included in the collection are the work of Johann Wolfgang von Goethe. Another specimen of note is the portrait of John Dryden by J. Richardson.

"Tapestries" contains excellent reproductions (three in each part) of well-known pieces in the Victoria and Albert Museum. Those illustrated in Part I. are "Chinoiseries," signed by John Vandrebanc, a tapestry weaver at one time established at Greek Street, Soho (late seventeenth or early eighteenth century); "Susannah and the Elders," probably Brussels work about 1500, and

"The Three Fates," also Brussels work, of the early sixteenth century. Part II. contains three collotype illustrations of "Children Playing," a set woven at Mortlake in the second half of the seventeenth century.

GENERAL NOTES.

Radium as a Fertiliser.—During the last year a series of very careful experiments has been conducted by Mr. Martin H. F. Sutton at Reading, with a view to test the value of radio-active ores as fertilisers. Mr. Sutton's interest in the matter was first aroused by statements in various scientific journals as to the somewhat surprising results which were said to have been obtained in Cornwall through the application of this ore to growing crops. The results of his first experiments led him to the conclusions, (1) that while in some cases plants dressed with radio-active ore had given better results than the control plants, the improvement was not of such a nature as to warrant the assumption that so expensive a commodity as radium could profitably be applied to crops; and (2) that very weak dressings of radio-active ore were quite as effective as strong ones, if not more so. A second series of experiments was then undertaken, in which the greatest possible care was taken to check the results. A summary of these results was recently prepared by Mr. Sutton, and the conclusion to which he was led was that in the particular experiments which he had conducted, at any rate, there was nothing to suggest that radium is likely to prove the wonderful stimulant to plant growth which some people have expected it to be.

Studio of Practical Design.—Under the auspices of the Imperial Arts League, a studio has been opened at 16, Dover Street, Piccadilly. It is intended to fill the gap which exists between the School of Art teaching and the practical work in the trade studios. Highly-skilled teachers, with complete technical knowledge of the industries, give instruction under the direction of Mr. W. G. Paulson Townsend, editor of *The Art Workers' Quarterly* and *The Annual of Art Work*. The application of design in relation to each particular branch of industries and craft is studied, and instruction is given in design for printed and woven fabrics, wallpapers, furniture, woodcarving, pottery, metalwork, embroidery, and lace. Hitherto the Germans have supplied our manufacturers with a large number of designs, which could have been produced by us had more attention been given to the technical requirements of trade. There is sufficient designing talent available in this country to improve our industrial art up to any conceivable standard of excellence, and with proper direction and due encouragement it is possible to impart new life to our art industries. The promoters of this studio aim at the improvement of British industrial design through the co-operation of the manufacturers and distributors. Periodical visits to manufacturers' workshops are arranged, so that students can obtain a more complete knowledge of the processes of production than the ordinary studio or school can provide.

Banana Flour.—Banana flour, according to the *Colonial Journal*, is now being used as a food in the French base hospitals. The banana yields about a quarter of its weight in meal, and the cost of meal in the West Indies is about 2*d*. per lb. Mixed with wheat flour it makes excellent loaves and cakes, and if wheat continues to advance in price it might be well to take a leaf out of the German book and use a second ingredient. This loaf is said to be quite as nutritious as the wheaten.

Reinforced-concrete Tramway Sleepers.—A writer in the *Commonwealth Engineer* describes the reinforced-concrete sleepers that have been laid in Adelaide to carry tram rails. The sleepers used are known as the "Joseph Timms." They are reinforced in conjunction with a metal shoe, on which the rail rests. The shoes are connected with reinforcing rods, and these are strengthened by intervening braces. The whole forms a truss bridge, which in itself is very strong, and is further strengthened by the addition of concrete. The ironwork of the sleeper is placed in a mould into which the concrete is poured, and the necessary tamping is done to ensure that every crevice is filled. The bottom of the sleeper has a concave surface, which is considered an improvement on the usual flat bottom, as it gives a better grip of the road bed. When the sleepers are laid the rails do not come in contact with the concrete, and all vibration is taken on the shoe. The initial cost per sleeper is, of course, considerably higher than in the case of wood or steel, but the durability is said to be immensely greater.

Siberian Trade Channels.—Attention is drawn in *Gas and Oil Power* to the investigations conducted during the past winter by the Siberian Association for Shipping, Trade, and Industry, which is now running its steamers to the estuaries of the Ob and Yenisei Rivers. The object of the investigations was to study the local markets and to organise extensive purchases of Siberian products, and the sale of such articles on a commission basis. The manager of the company has visited the most important producing centres of Siberia, such as Novo-Nikolayevsk, Atchinsk, Krasnoyarsk, and Omsk. The imports cover a wide range of articles, from agricultural machinery and electrical appliances to small domestic articles. The original plan of the organisation of the exchange of goods between Great Britain and Siberia has been widened, and the association has decided to extend its operations in the exchange of goods between Russia, England, and America, through Scandinavia. To utilise the natural wealth of the Siberian rivers, the company is establishing a fish cannery at the mouth of the Yenisei River.

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All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

HOUR OF MEETINGS.

The hour for the Ordinary Wednesday meetings of the Society and for the Cantor Lectures will, until further notice, be 4.30 p.m., instead of 8 p.m. This change has been made to meet the convenience of Fellows owing to the darkening of the streets at night.

CANTOR LECTURES.

The Cantor Lectures on "Oils, their Production and Manufacture," by F. Mollwo Perkin, Ph.D., F.I.C., F.C.S., M.Inst.P.T., have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Royal Society of Arts, John Street, Adelphi, London, W.C.

A full list of the Cantor and Howard Lectures, which have been published separately and are still on sale, can also be obtained on application.

EXAMINATIONS, 1915.

The changes in the system which were announced in the report on last year's examinations were satisfactorily carried out, and the duplication of the examinations—that is to say, the holding of them at two dates in the year instead of one—has on the whole proved a distinct success.

The most convenient date for holding such examinations as those of the Society has long been a matter of discussion. It is obvious that they should be held as near as possible to the end of the educational session. Now the date of this session varies in different localities, and it also varies as regards the more advanced or more elementary stages of instruction. At different times various proposals have been made, but it has never been found possible to secure unanimity.

In the course of last year certain inquiries were made by the Education Department of the London County Council with regard to the unification of the various examinations for which their schools send up candidates. Although the object of this inquiry was not attained, the practical outcome of the discussion was a proposal on the part of the Society to hold its examinations twice instead of once a year, so as to meet the requirements of those who preferred the earlier, and those who wished for a later, date. The offer was favourably considered by the Education Committee of the London County Council (the education authority for London), but the objection was raised that the Committee could not undertake to superintend two full examinations. The original proposal was therefore modified, so far as London was concerned, and it was arranged that the Elementary Examinations should be held before Easter, and the Advanced and Intermediate Examinations about Whitsuntide. As it was certain that some at all events of the centres outside London would not care for this arrangement, it was decided that in the provinces the whole of the examinations in all stages should be held twice in the year, the date for the first examination being fixed for March 22nd to 31st, and for the second examination May 10th to 19th.

The result was that in the Administrative County of London arrangements were made for the Elementary candidates to be examined in March, and those of the two higher stages in May. Throughout the rest of the country it was open to any school to hold its examinations either in March or in May, or if they preferred it at both dates. It would no doubt have been more satisfactory had it been possible to carry the change out thoroughly, and hold two examinations in all stages and in all the subjects. It was, however intended that the

arrangement for the current year should be merely tentative, and it was hoped that next year it might have been possible to organise two complete examinations, one in April and the second in May. But this anticipation has been brought to nothing by the upset which the war has caused in all educational arrangements, and all that it has been found possible to do has been to repeat the 1915 arrangements in 1916.

It should be understood that the new system involved a considerable concession on the part of the Society, inasmuch as the expenses were heavily increased, while a good deal of additional unpaid work was thrown on the Society's staff. It was, however, hoped that there would be a large increase in the number of candidates, and that their additional fees would reduce the loss, though they were not likely entirely to meet it. These calculations were entirely upset by the war, and instead of an increase there was, as set out in other parts of this report, a very considerable diminution in the number of candidates and a corresponding falling-off in the receipts, which only amounted to £3,646, as compared with £4,320 last year.

As the expenses of the examinations appear in the balance-sheet as £4,522, there is a loss of about £875 on this head. It should, however, be explained that this is not a loss on this year's working, since the receipts are those of 1915, and the amount on the other side represents the payments on the previous year's examination. The receipts, therefore, are diminished in consequence of the reduced number of this year's candidates, while the payments are those incurred for the larger number examined in 1914.

It is certain that the Society cannot stand such a drain on its resources, if it is to be continued in the future, and unless it is found that the receipts next year bear a more satisfactory relation to the outgoings, the whole question will have to be reconsidered. The Society has never made a profit on its examinations. For many years they were carried on gratuitously and at a serious annual cost. In 1880 a small fee was imposed, and since that date the examinations may be said to have been almost self-supporting. For a few years past there generally has been a trifling profit, but on the whole the Society has expended a very considerable sum of money in carrying out a work of admitted public utility, work which in any other country in the world would certainly have been undertaken by the State.

Financial considerations, however, apart, the experiment may be said to have proved a decided success. No difficulty whatever was found in carrying it out under the new system, and it appears to have met with general approval. It need hardly be doubted that under normal conditions the steady growth in the number of candidates which, as shown on the diagram on page 972 has been practically continuous for more than thirty years, would have been encouraged to even a more rapid rate by the additional facilities afforded, and there can be no reasonable doubt that in any ordinary year the number of entries would have considerably exceeded any that the Society has ever had to deal with.

It was, however, quite certain as soon as the war broke out that the examinations would be unfavourably affected in the same way as all other institutions and undertakings, and as a matter of fact far heavier losses were anticipated than were actually realised. Until the returns were received it was quite impossible to say what the actual numbers would be, though all inquiries showed that there would be a very considerable diminution on the numbers of 1914.

It is to be remembered that a large proportion of our male candidates in the two higher stages are of military age or just below it; and, further, that as a larger amount of overtime is now being worked, candidates have no time to attend evening classes. Many also of the young women who would ordinarily have been working for the Society's examinations have now taken the places of clerks and others who have enlisted. It appears certain that the falling-off in the numbers attending classes, especially those principally supported by young men, has been very great. In some of the large London Polytechnics the numbers of students for the winter session last year were as much as 40 per cent. below those of the previous year; and in the London County Council Commercial Institutes, which supply a considerable proportion of the London candidates, there was a diminution of about 30 per cent.*

* A recent report of the Board of Education, speaking of the effect of the war in diminishing the number of students at institutions supported or subsidised by Government, says: "For the Technical, Art, and Evening Schools it is not possible to give even approximate figures; but a number of the larger institutions have estimated the drop in the number of students owing to the war at points ranging up to 50 per cent., and averaging about 26 per cent." The Board a short time ago issued a circular announcing the discontinuance or the suspension of certain of its examinations.

The total number of entries for this year's examinations was 32,129—14,427 for the March examinations and 17,702 for those in May. The total shows a falling-off of 5,844 as compared with last year, when there were 37,973 entries. It should be understood that these figures represent, not the number of individual candidates, but the number of papers applied for. The falling-off amounted altogether to 15 per cent. In the County of London there was a deficiency of 28 per cent. In the provinces generally the deficiency was only 11 per cent.

There were 221 centres for the March examinations, and 252 for the May. 80 centres took both examinations. Last year there were 406 centres.

The number of candidates who actually came up for examination was 23,269. These 23,269 candidates worked 29,526 papers—Advanced 4,592, Intermediate (including Theory of Music 509) 11,350, and Elementary 13,584. Comparing the number of papers worked with those applied for we find a difference of 2,603 or 8.1 per cent. Why it is that so large a proportion should fail to present themselves after entering and paying their fees it is difficult to understand. The percentage this year is a little larger than usual.

The numbers of papers worked were divided between the two examinations as follows:—

	March.	May.	Total.
Advanced Stage . .	1,397	3,195	4,592
Intermediate Stage	4,043	7,307	11,350
Elementary Stage .	8,081	5,503	13,584
	13,521	16,005	29,526

As in 1914 there were 29,042 candidates, who worked amongst them 35,422 papers, the diminution this year is in the one case 5,773, and in the other 5,896.

The number of candidates examined in 1914—29,042—was the highest ever attained. The previous highest number of candidates entering for the examinations since 1883, when the present system began, was reached in 1911, when the total amounted to 28,644. In 1912 there was a decrease of 587, and in 1913 a further fall of 768, due to reasons stated in previous reports, and anticipated.

In addition to the 23,269 examined in the annual examinations, there were 453 candidates in Colloquial Modern Languages. The total number of candidates who were examined in all subjects by the Royal Society of Arts during the year ending July last, was, therefore, 23,722. Last year there were 29,971.

The general results of this year's examinations are given in Table A (page 967), and a comparative view of the numbers in the Higher Stages for the last six years (1910-15) is given in Table B (page 968). Tables C and D (page 969) show the percentage of successes and failures in all subjects of the two higher stages for the present year: while the percentage of successes and failures in all stages for the past six years are to be found in Table E (page 969). Table F (page 969) gives the number of candidates, papers, and subjects in the Elementary Stage since 1905. Table G (page 969) shows the number of papers worked in all stages during the last eleven years. Tables H and I (page 970) show the percentage of failures in the different subjects of the two higher stages for the last six years. Table K (page 971) gives the numbers of candidates examined during the same period. In Table L (page 971) are shown the results of the Viva Voce Examinations held at various centres during the current year.

The Commercial subjects included Book-keeping, Accounting, Banking, Shorthand, Typewriting, Economic History and Theory, Précis-writing, Theory and Practice of Commerce, Commercial Law, Company Law (added to the list this year), Economic Geography, Arithmetic, Handwriting, etc., Commercial Correspondence, etc., and English, French, German, Spanish and Italian. The other subject of examination was Music, divided into Rudiments of Music and Harmony.

The Society this year awarded thirty-two Silver and forty Bronze Medals, the former in the Advanced Stage and the latter in the Intermediate. It also gave away money prizes to the value of £104, besides the prizes, amounting to £40, provided annually by the liberality of the Clothworkers' Company.

In addition to these medals and prizes, the Scholarship offered by the London School of Economics was duly awarded for the Theory of Economics.

The Clothworkers' Company's prizes have been offered under various conditions since 1891. This year the sum of £40 was offered for prizes in Theory and Practice of Commerce, Commercial Law, Economic Geography, and Spanish.

While it is probable that the offer of medals

and prizes does not very largely affect the numbers entering for any given subject, it seems certain that it does attract a better class of student, and so helps in keeping up the general standard of the examinations. The awards are very highly valued, and are a great encouragement to those who win them; and there can be no doubt that if, as may very likely be the case, the Council are compelled by financial pressure to discontinue them for a year or to reduce their number, their absence will be a bitter disappointment to many of our best and most earnest students.

Certain alterations were made in the syllabuses for various subjects. These alterations, like those made last year, were intended to meet as far as possible the views believed to be held by the teachers of classes in those subjects, and also to bring the examinations into greater harmony with the character of the commercial instruction now being given in the schools under the Board of Education.

No new subjects were added, but Accounting and Banking were separated, and now form two subjects instead of being combined in one. Company Law has been made into a separate subject, instead of being included in Commercial Law. Commercial History was separated from Commercial Geography, and forms a separate subject under the title of Economic History. The subject of Economics is now restricted to the Theory of Economics, and is so entitled.

Certain other alterations were made in the syllabuses of the modern language subjects. In all these subjects certificates are now granted in the two lower stages on a general knowledge of the language alone. In Stage III. the candidates are expected to specialise to a certain extent, and must show a literary, technical, commercial, or scientific knowledge, as well as a good general knowledge of the language.

It was always a source of complaint that candidates had to wait a long time before they could know the results of their examinations. A new system of publication of the results of the examinations has been started this year, and has been much appreciated. The candidates fill in a counterfoil attached to the paper on which they do their work; on these counterfoils the result of the examination is marked, and they are returned to the centres as soon as possible. By this means candidates are informed of the result of their examination some weeks sooner than in former years, when they had to wait until all the papers had been reported on and classified, and the printed results issued.

The results of the March examinations were sent to the centres concerned, the Advanced on April 24th, the Intermediate on May 12th, and the Elementary Stage on June 1st.

The results of the May examinations were issued—the Advanced Stage on June 29th, the Intermediate on July 16th, and the Elementary on July 27th. The complete list of all the results, classified under localities, was published early this month.

It may be interesting to compare the number of male and female candidates who obtained certificates at the current year's examinations. Of the 15,760 candidates who passed, 8,330, or 52·85, were males, and 7,430, or 47·15, females. Among the candidates from provincial centres the proportion of males is larger, there being 54·22 per cent., while females are 45·78. In London the proportions go the other way, and the females are more numerous, in the proportion of 52·50 to 47·50. This is due to the fact that the private institutions in London sent in 730 young women and 400 young men. In the London County Council Institutes the males are in a larger number, there being 1,120 to 950 females. It may be added that the Scotch centres also show a larger proportion of females. No precise calculation has been made for any previous year, but it is probable that three or four years ago the proportion of females was under 15 per cent. of the whole.

As has been the case for many years past, the numbers in Book-keeping are still ahead of those in any other subject, though as compared with last year—when there were 11,883 candidates, by far the highest number examined in any year—the figure has been sadly reduced, since there were only 8,960, a falling-off of not far short of 25 per cent. The proportional falling-off is greatest in the two higher stages, there being, as compared with last year, a diminution in Stage III. of 779, in Stage II. of 1,028, and in Stage I. of 1,116. None of the other large subjects show the same amount of loss as this. Up to last year the growth in this subject had been continuous for the past five years, and we have to go back to 1910, when 9,714 candidates were examined, to approach the level of the present year. In the Advanced Stage the examiner notes that on the whole the work submitted was creditable. The first-class certificates show an increase of 1·74 per cent., the second-class

a decrease of 2·39 per cent., and the failures an increase of 0·65 per cent. In the Intermediate and Elementary Stages the work was also creditable, but did not show any advance on previous years.

The next most popular subject was Shorthand. In this there was a falling-off of 1,276, there being 6,539 candidates examined this year as compared with 7,815 last. It will be noticed that the proportion is not nearly as large as that in Book-keeping, amounting to about 16 per cent. The examiner remarks that the results in all stages do not indicate any very marked variation on those of previous years, and they have quite come up to his expectations. In all cases the percentage results show an improvement upon the work of last year, when it appears probable that the papers set were a little above the usual standard of difficulty, and it may be this fact, rather than any definite improvement, which causes the rather larger proportion of successes. The standard in this subject has always been kept rather high, and, as remarked last year, a certificate in the first class of the Advanced Stage has always been looked upon as a certain passport to employment. The examiner considers that the work generally is quite up to the level of previous years. He also notes that the results in the two examinations correspond satisfactorily. His remarks upon the mistakes made by the candidates should, as usual, be carefully studied both by students and teachers. Indeed, both candidates and their teachers may very well be recommended to read carefully the reports of the examiner for the last few years.

The entries in Typewriting have kept up rather better than in the two subjects previously mentioned. This year there were 2,566, and last year 2,806, a falling-off of 240. The proportion of loss is highest in the Advanced Stage and smallest in the Elementary. The examiner considers that, taken as a whole, there was a pronounced improvement both in quality and quantity of the work submitted. As in the case of Shorthand, the examiner's comments on the papers are well worth the study of prospective candidates and their teachers.

It was noted in last year's report that there had been a steady growth in the numbers entering for the very important subject of Arithmetic. The increase naturally has been stopped for this year, but the falling-off is not excessive—419 as compared with last year, or 13 per cent. The actual numbers are 2,806 for the current year, and 3,225 for 1914. The diminution is spread over all three stages. So far as can be judged from the percentage results, the character of the papers in Stage III. shows an improvement, and of those of Stage II. practically no change. In the opinion of the examiner there is on the whole an improvement in all stages. Special attention may be drawn to the solutions which have been worked out by the examiner for the papers set at both the March and May examinations.

English is one of the very few subjects which show an actual increase in the number of papers worked at the present year's examinations. Last year there were 743, this year 816—a total increase of 73. This increase manifests itself in Stages III. and I., and there is a very small falling-off in Stage II. The work on the whole was, in all three stages, according to the examiner's opinion, satisfactory, and it looks as if there is a slight advance on last year. There is certainly no falling-off, though the general average is kept down, especially in the Elementary Stage, by a number of candidates whose work was extremely feeble. On the other hand, this same stage showed a considerable number of candidates whose work was really very good. The very full comments by the examiner on all the papers set are well worth a careful study.

As previously noted, there was a certain rearrangement of the subjects dealing with Economics, and instead of having a single subject under the title of Economics, and another under Commercial History and Geography, the whole subject has been divided into three—Economic Theory, Economic History, and Economic Geography. With regard to the last mentioned Economic Geography—there is a certain diminution, as there were 246 candidates, compared with 282 last year—a total loss of 36. Having regard to the fact that Commercial History was taken away from this subject and made into a subject of its own, this falling-off cannot be considered as very serious. It is, however, deplorable that so few candidates as 18 should come up for the examination in the Advanced Stage, and only 38 in the Intermediate Stage. The entry of 190 for the Elementary Examination cannot be considered as unsatisfactory, though it is a matter for regret that more attention should not be given to this very important subject in the teaching institutions from which the Society's candidates are for the most part drawn. As regards Stage III., the examiner considers that the work was poor and generally

inferior to the standard of that done by candidates in the Intermediate Stage. In the latter stage the work of those who entered for the March examination was inferior, but in May the work was a great deal better. In the Elementary Stage the work of the candidates was about normal.

For Economic History 24 candidates entered —14 in the Advanced Stage and 10 in the Intermediate. For Economic Theory 103 entered—47 in the Advanced and 56 in the Intermediate Stage. For the two subjects together we get a total of 127, which compares with 158 who entered in 1914 for the one subject of Economics; there is thus a falling-off of 31. As regards Economic History, the examiner considers that the general results were good. In the Advanced Stage the general level reached was distinctly good, and the papers showed evidence as a rule of careful and intelligent study. In the Intermediate Stage the general quality was satisfactory, and there were a few papers of great merit. As regards Economic Theory, in the Advanced Stage a little less than half the papers attained a high level, both for knowledge of the subject and ability in stating that knowledge. The other half did fairly well, though in some instances they did not avoid failure by a large margin. The number of total failures was small in the Intermediate Stage, a fair proportion showed a good knowledge of the subject, and the candidates wrote with vigour and intelligence about it. The number of failures was not great, but many candidates only just reached a satisfactory level.

The entries for the subject of Précis-writing have of late years shown a decline in numbers, though there was an increase over some previous years in 1914. This year there were 138 candidates—a falling-off of 60 on the 198 of last year, or 33 per cent. Although the numbers are not very large, this is a very heavy proportionate decrease. On the whole the standard appears to be much the same as that of recent years, and it is certainly not any better.

The number of candidates entering for Commercial Law was no doubt affected by the splitting of this subject up into two, and the consequent addition of Company Law. 184 entered for the first-named subject, and 104 for the second, 288 altogether. This shows a small falling-off on the 308 of last year. As regards Commercial Law, the examiner considers that the average merit of the papers worked reached about the same level as in previous years. In Company Law the papers were purposely made rather easy, and it may be hoped that the standard may be raised in future years. As regards both subjects the attention of the candidates may be drawn to the examiner's comments.

The subject of Accounting and Banking has this year been cut in two, and separate papers were set in Accounting and in Banking. 384 entered for the first-named subject, and 125 for the second. This total of 509 shows an increase of 21 on the 488 candidates who entered for the one subject in 1914. Having regard to the general depression this year this may be considered a very satisfactory result, and it quite justifies the alteration in the syllabus. In the examination in Accounting, the examiner reports that some of the work submitted was excellent, and as a whole the average merit attained was creditable. In Banking the examiner considers that on the whole the work sent in was satisfactory, though some few candidates entered for the examination without adequate preparation.

233 candidates entered for the examinations in the Theory and Practice of Commerce—83 in the Advanced, and 150 in the Intermediate. This subject offers a rare example of an increase in the number of candidates. The total increase over the 154 of last year was 79—72 in Stage II. and 7 in Stage III. In both stages the examiner finds that there was a small proportion of first-class papers, and, as regards the May examination in Stage II., there was too large a proportion of failures, though in March the number of failures was slightly less than last year.

The popularity of the examination in Commercial Correspondence and Business Training is shown by the fact that it also shows an actual increase in numbers. The number of candidates, 606, is indeed the highest yet reached. In 1913 there were 603, and last year the numbers dropped a little to 588. The examination in this subject is in the Intermediate Stage only, and candidates capable of taking a higher certificate may be advised to study for the examination in Theory and Practice of Commerce. At the same time it is quite clear that a large number of young students appreciate the easier test. In the opinion of the examiner, the papers generally are of much the same character as last year, and the percentage results show a slight improvement in the first class, a falling-off in the second, and an increased number of failures.

In the corresponding subject in the Elementary Stage—Handwriting and Correspondence there were 1,666 papers worked, a falling-off of 246 on the 1,912 of last year. It may be taken that these numbers show the considerable popularity of this subject. On the whole the papers this year were, in the examiner's opinion, a little better worked than last year.

The number of candidates in French compares not unfavourably with that of last year, though there is a falling-off of 170, there having been 2,784 candidates examined in the current year and 2,954 last year. The falling-off appears in all three stages. For some reason which it is difficult to suggest, the number of entries for French has not shown of recent years the same tendency to increase as is manifested in most other subjects, though it has always been one of the most popular subjects, and has regularly attracted a large number of entries. In 1911 there were 3,647 papers worked, and there has been no entry like this in any year since. In all stages there was a distinct improvement in the character of the work sent in. The examiner reports the work in Stage III. as excellent, and better than last year. In Stage II. there were some first-class papers, and a smaller number of failures, while in Stage I. there were more good papers than usual.

That there should have been a heavy falling-off in the German results is by no means surprising, and perhaps it is a matter for no great regret. Indeed, it had been a question for consideration whether, under existing circumstances, it was desirable to hold any examination in German at all. On the whole, however, it seemed better to let matters take their usual course. There is no doubt that in the future the commercial value of the German language will be very much less than it was before the war; but whatever the ultimate issue may be, a knowledge of the language must be valuable, and if there is no particular reason to encourage its study, on the other hand it does not seem wise to restrict existing facilities. The total number of German papers, 462, was a little more than half that of last year, 826, which again was less than the previous year, there having been a steady falling-off in the number of entries since 1912, previous to which year there had been for some time a regular increase. In Stage III. both in March and May the work was exceptionally good. In Stage II. the improvement was not so marked, and in Stage I. the general average was higher than it had been for some years.

The number of entries in Italian was inconsiderable, not very much above half the number last year—there were only 44. Last year there were 76. The entries for this language are never very numerous; but as a rule the work is fairly good, and this in the examiner's opinion was the case this year on the whole, while the excellence of the papers in the Advanced Stage was noticeable. Since the examinations were completed the Society has lost the services of Professor Luigi Ricci, the accomplished Italian scholar, who had acted as the Society's Examiner in Italian since the year 1904.

The number of candidates in Spanish kept up moderately well, there being 227 as against 355 last year. They were equally divided among the three stages—74 in Stage III., 76 in Stage II., and 77 in Stage I.

No other examinations were held in any of the other modern languages in the Society's list. For some years past the Society has expended a good deal of money in trying to encourage the study of the less popular languages, and has held examinations in Russian, Danish and Norwegian, Hindustani, Japanese, Chinese, Arabic, Swedish and Dutch. The old rule was that no examination would be held in any subject for which less than 25 candidates presented themselves, but this regulation was ignored in the hope that the numbers would increase if the study of the languages could be rendered more popular. As a result, taking the last six years, only 216 candidates entered, at a cost of about £350, and this, after deducting the £27 paid by the candidates in fees, meant a net loss of £323, or say £1 10*s.* per candidate. It was therefore determined to enforce the strict rule, and as the entries in the above-named subjects were very few, no examination was held this year in any of them.

Inasmuch as special efforts are being made by the Education Committee of the London County Council to encourage the formation of the study of Russian, it is to be hoped that a sufficient number of candidates may be forthcoming to justify the holding of an examination. It may be added that even if quite the stipulated number do not enter, the Society will probably make an exception in this particular case. Since it may be considered certain that our business relations with our Ally will develop in the future, a knowledge of Russian will be a valuable asset to those entering a commercial career.

For the Viva Voce Examinations held this year in Modern Languages 428 candidates entered at London centres and 25 at Manchester. Last year examinations were held also at Liverpool, Birmingham, and Bristol, but at these centres no entries were made this year. This number shows a heavy falling-off as compared with last year, when there were 628. These examinations were started in 1902, when 280 candidates were examined. The numbers rose to 681 in 1905; after that there was a small diminution, the numbers varying slightly year by year, and falling to 583 in 1911, then they increased again to 688 in 1913, and this was the highest point yet reached. Examinations were held this year in French, German, Spanish, and Italian. The numbers were: French, 339; German, 79; Spanish, 25; Italian, 10. Table L (page 971) gives in detail the results of this year's examinations.

The examiner in colloquial French states that, as usual, the results of this examination were very satisfactory and the proficiency of the candidates most praiseworthy. The presence of the Belgian refugees in our midst has seemingly been turned to good account. The work in German was good, though naturally enough the entries in this subject were not numerous. On the whole, the examiner says the work was excellent, and a large proportion of candidates earned distinction. Very many of the candidates displayed a really remarkable power of easy and fluent speech. The results of the Spanish and Italian examinations were much of the same character as in previous years.

These examinations are held at any of the Society's centres where the necessary arrangements can be made, at any date convenient to the local committee. The examination includes dictation, reading, and conversation, and is so arranged as to test efficiency in colloquial knowledge of the language, without laying too much stress on minute grammatical accuracy. Candidates who are reported upon as highly qualified by the examiners receive a certificate of having passed with distinction.

The examinations in Rudiments of Music and Harmony were carried on as usual at the same time as the Commercial examinations, and the results appeared as part of the results of the Intermediate Stage. The total number of candidates was 509, a decrease of 78 on last year's figures. This falling-off has been practically continuous for the past six years, and the present year is the lowest for the past ten. The figures are 587 in 1914, 617 in 1913, 688 in 1912, 691 in 1911, 619 in 1910, 699 in 1909, 716 in 1908, 641 in 1907, and 637 in 1906.

In Rudiments of Music 254 candidates presented themselves; last year there were 342. In Harmony there were 255, as compared with 245. Of the 254 candidates in Rudiments of Music, 202 passed and 52 failed. Of the 255 candidates in Harmony, 190 passed and 60 failed. The results do not differ very much from those of recent years, the proportion of successes and failures being singularly constant.

There were no Practical Examinations in Music this year, these examinations having been discontinued after 1914. An account of the history and progress of these examinations will be found in the Report on the Examinations of 1914, and in the Council Report for the Session 1914-15.*

The special annual examination in Shorthand for soldiers has not been held this year. It was started in 1907 at the request of the Army Council, and has been held every year since. In 1907 there were 40 candidates; in 1908, 84; in 1909, 60; in 1910, 66; in 1911, 61; in 1912, 45; in 1913, 51; in 1914, 57.

The Examination Programme for 1916 was issued on the 4th inst. In it will be found the fullest possible information about the examinations, a syllabus of each stage of each subject, and the papers set in May, 1915.† The attention of both teachers and students may be drawn once more not only to the syllabuses but also to the remarks of the various examiners on the results of last year. It will be found that these contain many valuable and helpful suggestions, and the work of the candidates year after year shows that far too little attention is paid to them. Teachers especially are earnestly recommended to study these remarks, as they ought to be guided by them in the instruction they give to their pupils.

The regulations for the Examinations in the Theory of Music, and those for the Viva Voce Examinations in Modern Languages, are also given at full length.

* See *Journal*, Vol. LXII. p. 919 and Vol. LXIII. p. 715.

† The price of the Programmes for 1914, 1915 and 1916 is 4*d.* each, post free 6*d.* Copies can be obtained on application to the Secretary of the Royal Society of Arts, Adelphi, London, W.C. Programmes containing the papers set from 1905 to 1912 can also be obtained (price 3*d.* each year, post free 4½*d.*). The papers set in March, 1915, are not included in the 1916 Programme. They are printed in a separate pamphlet, price 2*d.* (post free 3*d.*). The regulations and syllabuses for the present year can also be had separately (without the papers), price 1*d.*, by post 1½*d.*

TABLE A.—DETAILS OF THE 1915 EXAMINATIONS.

Subjects	Stage III.—Advanced				Stage II. Intermediate and Music							Stage I.—Elementary			Total number of Papers worked in all Stages
	Papers worked	1st-class Certificates	2nd class Certificates	Not passed	Papers worked	1st-class Certificates	2nd class Certificates	Music Certificates: Higher	Music Certificates: Inter-mediate	Music Certificates: Elementary	Not passed	Papers worked	Passed	Not passed	
Arithmetic	118	19	51	48	659	116	352	..	..	..	191	2,029	1,429	600	2,806
English	53	10	25	18	260	46	137	..		..	77	503	299	204	816
Book-keeping	1,690	217	847	626	3,267	508	1,915		..	..	844	4,003	2,491	1,512	8,960
Economic Geography	18	1	7	10	38	2	23	..		..	13	190	118	72	246
Shorthand	562	54	286	222	3,449	812	1,351	..		..	1,256	2,528	1,839	689	6,539
Typewriting	200	40	93	67	931	304	426	..		..	201	1,435	988	447	2,566
Economic History	14	4	8	2	10	4	5	..		..	1	..	..	..	24
Economic Theory	47	9	29	9	56	19	33	..	..	..	4	..	..	..	103
Précis-writing	58	8	30	20	80	12	44	..	..	..	24	..	..	..	138
Commercial Correspondence and Business Training	..	..	..	..	606	62	356	..	..	..	188	..	..	..	606
Commercial Law	184	23	91	70	..	..	..	..	..		..	..	..	..	184
Company Law	104	12	59	33	..	..	..	..	..		..	..	..	..	104
Accounting	384	48	208	88	..	..	..	..			..	..	..	..	384
Banking	125	22	71	32	..	..	..	..	..		..	..	..	..	125
Theory & Practice of Commerce	83	9	44	30	150	15	64		..	..	71	..	..	..	233
French	756	148	465	143	1,063	171	695	..	..	..	197	965	603	362	2,784
German	109	42	45	22	176	36	86	..	..	..	54	177	129	48	462
Italian	13	4	6	3	20	9	7	..	..	..	4	11	9	2	44
Spanish	71	5	43	26	76	13	48	..	..	..	15	77	54	23	227
Handwriting and Correspondence	..	..	..	..	..	..	..	..	..	..	..	1,666	1,045	621	1,666
Rudiments of Music	..	..	..	..	254	..	..	107	..	95	52	..	..	..	254
Harmony	..	..	..	..	255	..	..	32	68	90	65	..	..	..	255
Totals	4,592	715	2,408	1,169	11,350	2,159	5,542	139	68	185	3,257	13,584	9,001	4,580	29,526

TABLE B.—NUMBER OF PAPERS WORKED IN EACH SUBJECT OF STAGES III. AND II. IN 1910-11-12-13-14-15.

SUBJECTS.	1910.			1911.			1912.			1913.			1914.			1915.		
	Stage III.—Advanced.	Stage II.—Intermediate.	Totals.	Stage III.—Advanced.	Stage II.—Intermediate.	Totals.	Stage III.—Advanced.	Stage II.—Intermediate.	Totals.	Stage III.—Advanced.	Stage II.—Intermediate.	Totals.	Stage III.—Advanced.	Stage II.—Intermediate.	Totals.	Stage III.—Advanced.	Stage II.—Intermediate.	Totals.
Arithmetic	148	638	786	177	731	908	93	690	783	93	669	762	132	733	865	118	659	777
English	91	341	432	134	351	485	87	357	444	63	303	366	78	271	349	53	260	313
Book-keeping	2,049	3,849	5,898	2,265	4,287	6,552	2,156	4,127	6,283	2,179	4,118	6,297	2,469	4,295	6,764	1,690	3,267	4,957
Commercial History and Geography	25	117	142	47	84	131	24	60	84	19	44	63	13	41	54	..	..	..
Economic Geography	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	18	38	56
Shorthand	866	4,464	5,330	867	4,344	5,211	774	4,120	4,894	755	4,174	4,929	740	4,134	4,874	562	3,449	4,011
Typewriting	245	849	1,094	222	887	1,109	224	885	1,109	213	824	1,037	244	974	1,218	200	931	1,131
Economics	63	68	131	55	83	138	59	91	150	55	110	165	64	94	158	..	..	..
Economic History	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	14	10	24
Economic Theory	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	47	56	103
Précis-writing	63	129	192	94	268	362	72	144	216	63	98	161	66	132	198	58	80	138
Theory and Practice of Commerce			.	..	.	..	..	.	..	..	..	..	76	78	154	83	150	233
Commercial Correspondence and Business Training	..	..	..	..	303	303	..	454	454	..	603	603	..	583	583	..	606	606
Commercial Law	237	..	237	247	..	247	380	..	380	297	..	297	308	..	308	184	..	184
Company Law	..	.	..	..	..	..	..	.	.	..	..	..	..	..	..	104	..	104
Accounting and Banking	407	..	407	499	..	499	476	..	476	490	.	490	488	..	488	..	..	..
Accounting	..	.	..	..	..	..	..	..	..	.	.	..	..	..	..	384	..	384
Banking	..	..	..	..	.	..	..	..	..	..	..	..	..	..	..	125	..	125
French	807	1,283	2,090	967	1,488	2,455	793	1,497	2,290	756	1,293	2,049	793	1,181	1,974	756	1,063	1,819
German	160	317	477	212	354	566	224	332	556	197	303	500	188	280	468	109	176	285
Italian	28	14	42	25	28	53	20	12	32	17	22	39	23	33	51	13	20	33
Spanish	82	121	203	81	90	171	73	97	170	72	86	158	117	92	209	74	76	150
Portuguese	25	13	38	16	16	32	14	10	24	13	15	28	20	9	29	..	..	..
Russian	2	9	11	4	6	10	2	8	10	3	8	11	8	9	17	..	..	..
Danish and Norwegian	7	4	11	10	5	15	6	6	12	5	5	10	3	4	7	..	..	..
Hindustani	..	..	..	2	3	5	..	..	..	..	..	..	..	1	1	..	..	..
Swedish	4	5	9	7	4	11	6	.	6	3	3	6	..	4	4	..	..	..
Japanese	..	1	1	..	2	2	.	5	5	.	.	..	.	..	..	..	..	..
Chinese	..	2	2	..	.	.	.	..	.		.	.	..	..	..	..	..	..
Arabic	..	.	..			.	.		.	..	7	7	..	3	3	..	..	..
Dutch	..	..	..	.					.		..	.	2	6	8	.	..	..
Totals	5,309	12,224	17,533	5,931	13,334	19,265	5,483	12,895	18,378	5,293	12,685	17,978	5,832	12,957	18,789	4,592	10,841	15,433

TABLE C.

PERCENTAGES OF SUCCESSES AND FAILURES, ADVANCED STAGE, 1915.

	First class	Second class	Failures
Arithmetic	16·09	43·23	40·68
English	18·87	47·17	33·96
Book-keeping	12·84	50·06	37·10
Economic Geography . .	5·55	55·55	38·90
Shorthand	9·61	50·89	39·50
Typewriting	20·00	46·50	33·50
Economic History . . .	28·50	57·00	14·50
Economic Theory . . .	19·00	62·00	19·00
Précis-writing	13·79	51·73	34·48
Commercial Law . . .	12·50	49·46	38·04
Company Law	11·54	56·73	31·73
Accounting . . .	22·92	54·17	22·91
Banking	17·60	56·80	25·60
Theory and Practice of Commerce	10·84	53·01	36·15
French	19·58	61·51	18·91
German . . .	38·53	41·29	20·18
Italian . . .	30·77	46·12	23·11
Spanish	6·76	58·10	35·14

TABLE D.

PERCENTAGES OF SUCCESSES AND FAILURES, INTERMEDIATE STAGE, 1915.

	First class	Second class	Failures
Arithmetic	17·60	53·42	28·98
English	17·69	52·69	29·62
Book-keeping	15·55	58·59	25·86
Economic Geography . .	5·26	60·53	34·21
Shorthand	24·41	39·17	36·42
Typewriting	32·65	45·76	21·59
Economic History . . .	40·00	50·00	10·00
Economic Theory . . .	33·93	58·93	7·14
Précis-writing	15·00	55·00	30·00
Commercial Correspondence and Business Training .	10·23	58·75	31·02
Theory and Practice of Commerce	10·00	42·66	47·34
French	16·09	65·38	18·53
German	20·46	48·86	30·68
Italian	45·00	35·00	20·00
Spanish	17·10	63·16	19·74

TABLE E.

PERCENTAGES OF SUCCESSES AND FAILURES IN ALL STAGES, 1910-11 12 13-14-15.

Advanced (Stage III.).

	1910	1911	1912.	1913.	1914	1915.
First-class	12·60	11·64	11·42	14·70	13·92	15·57
Second-class	53·38	48·15	47·09	58·17	50·19	52·44
Failures .	34·02	40·21	41·49	27·13	35·89	31·99

Intermediate (Stage II.).

	1910	1911	1912.	1913.	1914	1915.
First-class	12·77	15·78	15·27	10·88	15·13	19·92
Second-class	52·47	56·00	55·91	58·18	52·79	51·12
Failures .	34·76	28·22	28·82	30·94	32·08	28·96

Elementary (Stage I.).

	1910	1911	1912.	1913.	1914	1915.
Passes . .	66·80	64·69	64·99	61·08	63·46	66·28
Failures .	33·20	35·31	35·01	38·92	36·54	33·72

TABLE F.

ELEMENTARY EXAMINATIONS, STAGE I.

Year	No. of candidates	No. of papers worked	No. of subjects.
1905	7,397	8,427	10
1906	7,425	8,537	10
1907	7,692	8,952	10
1908	8,276	9,811	10
1909	9,136	11,069	10
1910	10,289	12,720	10
1911	11,277	14,286	10
1912	11,448	14,936	10
1913	11,096	14,611	10
1914	12,104	16,046	11
1915	10,000	13,584	11

TABLE G.

NUMBER OF PAPERS WORKED IN ALL STAGES, 1905-6-7-8-9-10-11 12-13-14-15.

	Stage III.	Stage II	Stage I	Total.
1905	4,844	10,533	8,427	23,804
1906	4,904	10,734	8,537	24,175
1907	4,815	10,802	8,952	24,569
1908	4,795	11,199	9,811	25,805
1909	5,433	12,512	11,069	29,014
1910	5,309	12,843	12,720	30,872
1911	5,931	14,025	14,286	34,242
1912	5,483	13,583	14,936	34,002
1913	5,293	13,302	14,611	33,206
1914	5,832	13,544	16,046	35,422
1915	4,592	11,350	13,584	29,526

The numbers for Stage II. include the papers set in Music.

TABLE H.

PERCENTAGES OF FAILURES IN ALL SUBJECTS, ADVANCED STAGE, 1910-11-12-13-14-15.

	1910.	1911.	1912	1913.	1914.	1915.
Arithmetic	44·00	45·76	50·52	50·53	58·00	40·68
English	34·07	34·33	48·27	41·27	32·05	33·96
Book-keeping	36·40	45·21	49·12	26·48	36·45	37·10
Commercial History and Geography	44·00	51·10	37·50	21·05	46·15	..
Economic Geography	..	..	..	..	..	38·90
Shorthand	38·11	60·32	60·73	25·30	63·11	39·50
Typewriting	59·59	24·78	32·59	27·70	34·43	33·50
Economics	31·75	45·46	25·42	14·54	18·75	..
Economic History	..	..	..	..	..	14·50
Economic Theory	..	..	..	..	..	19·00
Précis-writing	26·98	30·86	29·17	26·98	30·30	34·48
Commercial Law	39·24	15·35	35·00	38·38	35·39	38·01
Company Law	..	..	..	..	..	31·73
Accounting and Banking	25·80	27·25	28·56	27·35	27·26	..
Accounting	..	..	..	..	..	22·91
Banking	..	.	..	..		25·60
Theory and Practice of Commerce	..	..	..	..	31·20	36·15
French	19·44	22·96	22·07	19·81	18·66	18·91
German	23·75	32·10	31·25	41·12	28·19	20·18
Italian	11·28	12·00	10·00	11·77	13·05	23·11
Spanish	45·12	35·80	23·30	33·34	22·22	35·14
Portuguese	16·00	25·00	14·29	7·72	10·00	.
Russian	0·00	0·00	0·00	0·00	0·00	.
Hindustani	..	0·00	..	..		.
Danish and Norwegian	14·28	30·00	0·00	0·00	0·00	.
Swedish	0·00	14·00	50·00	33·31	0·00	.
Dutch	..	..	..	.	100·00	.

TABLE I.

PERCENTAGES OF FAILURES IN ALL SUBJECTS, INTERMEDIATE STAGE, 1910-11-12-13-14-15.

	1910	1911	1912.	1913	1914	1915
Arithmetic	31·98	32·97	29·71	27·95	28·78	28·98
English	28·17	28·49	28·57	36·30	21·77	29·62
Book-keeping	30·76	32·63	33·44	26·52	25·28	25·86
Commercial History and Geography	29·06	36·91	26·66	27·27	34·15	..
Economic Geography	..	..	..	..	..	34·21
Shorthand	43·06	25·27	23·18	40·10	45·50	36·12
Typewriting	32·27	28·07	34·01	25·97	33·58	21·59
Economics	19·12	16·87	15·38	15·45	16·00	..
Economic History	..	..	..	..	..	10·00
Economic Theory	..	..	..	..	..	7·14
Précis-writing	27·91	29·11	25·70	22·45	25·76	30·00
Theory and Practice of Commerce	..	..	..	..	29·50	47·31
Commercial Correspondence and Business Training	..	31·68	34·36	31·67	21·27	31·02
French	26·58	22·45	25·05	18·64	20·32	18·53
German	32·49	21·47	39·76	42·90	33·22	30·68
Italian	14·29	17·86	16·67	22·73	21·22	20·00
Spanish	23·97	34·44	28·86	23·26	32·61	19·74
Portuguese	30·77	31·25	60·00	40·00	55·56	..
Russian	44·44	33·34	37·50	0·00	22·23	..
Danish and Norwegian	0·00	0·00	33·33	20·00	0·00	..
Swedish	20·00	75·00	..	66·66	50·00	..
Japanese	100·00	100·00	60·00	..	..	..
Hindustani	..	33·34	..	..	100·00	..
Chinese	0·00	..	..	..	..	..
Arabic	..	..	..	42·86	0·00	..
Dutch	..	..	..	..	33·34	..

TABLE K.

CANDIDATES EXAMINED IN 1910-11-12-13-14-15.

	1910.	1911.	1912.	1913.	1914.	1915.
Commercial Knowledge—						
Stage III.—Advanced	4,654	5,134	4,754	4,618	5,065	3,715
Stage II.—Intermediate (including Theory of Music) . . .	11,340	12,233	11,855	11,580	11,873	9,554
Stage I.—Elementary	10,289	11,277	11,448	11,096	12,104	10,000
Totals	26,283	28,644	28,057	27,294	29,042	23,269
Music (Practice)	339	283	296	273	244	—
Colloquial Modern Languages . .	612	583	633	688	628	453
Army Candidates	66	64	45	51	57	—
Totals in all Subjects . .	27,330	29,574	29,031	28,309	29,971	23,722

TABLE L.

VIVA VOCE EXAMINATIONS HELD DURING 1915

Centre of Examination.	Date	Number of Candidates.	Passed with Distinction.	Passed.	Failed.
French :—	1915				
Manchester Education Committee .	April 22 .	12	3	5	4
Tottenham Polytechnic	April 29	16	3	9	1
Acton and Chiswick Polytechnic	May 1	26	4	12	10
Enfield Technical Institute	May 7 .	34	6	24	4
Kensington College	May 20 .	37	23	12	2
City of London College (Candidates from London Polytechnics)	May 21	25	8	12	5
Regent Street Polytechnic	May 27 .	14	7	2	5
,, ,, ,, (Candidates from London Polytechnics)	May 28 .	15	9	5	1
Pitman's School	May 31 .	25	13	10	2
,, ,, (Candidates from London Polytechnics) . .	June 1 .	21	12	9	3
Borough Polytechnic (Candidates from London Polytechnics) .	June 3 .	23	6	12	5
Barnsbury Park L.C.C. Institute	June 14 .	19	4	12	3
William Street L.C.C. Institute.	June 15 .	22	13	4	5
St. Clement Danes' School (Candidates from L.C.C. Institutes)	June 16	23	7	13	3
Choumert Road L.C.C. Institute	June 17 .	24	8	12	4
German :—					
Manchester Education Committee	April 27 .	7	1	5	1
Regent St. Polytechnic (Candidates from London Polytechnics)	June 3 . .	18	7	7	4
City of London College (Candidates from London Polytechnics)	June 7 . .	17	11	5	1
Pitman's School	June 8 .	21	14	7	..
St. Clement Danes' School (Candidates from L.C.C. Institutes)	June 10 .	16	5	9	2
Spanish :—					
Manchester Education Committee	April 20	6	2	2	2
Pitman's School (Candidates from London Polytechnics) . .	June 9 .	19	4	11	4
Italian :—					
Regent St. Polytechnic (Candidates from London Polytechnics)	June 8 .	10	3	7	..
	Totals	453	173	206	74

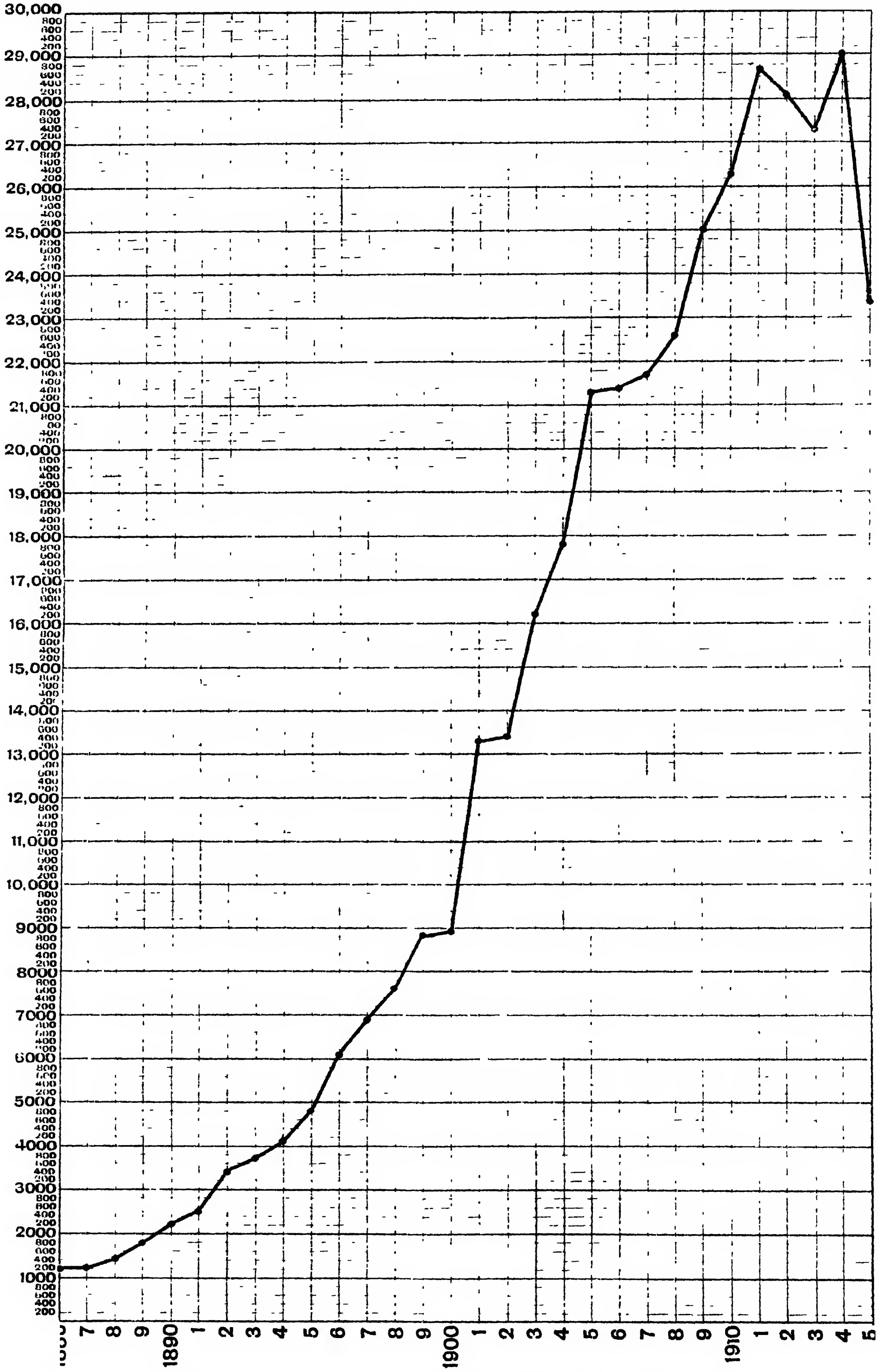

Diagram showing Progress of Examinations, 1886–1915.
(Number of Candidates.)

SEA ROUTE TO SIBERIA.

The *Times* publishes some interesting particulars relating to the arrival at Grimsby of the steamers "Haugastoel" and "Eden," chartered by the Siberian Steamship Manufacturing and Trading Company (Limited), which have brought cargoes of butter, hemp, flax, and other produce, valued at £350,000, from the Yenisei and Obi districts of Central Siberia. An account of this enterprise appeared in the *Journal* of February 12th, 1915 (p. 254), and its successful accomplishment may be considered an important event in the history of the attempts to establish a sea route to Siberia *via* Norway and the Kara Sea.

The practicability of this route was first demonstrated by Captain Wiggins, who in 1874 sailed from Dundee in the Arctic yacht "Diana," proceeded up the Obi Gulf, cruised over towards the mouth of the Yenisei River, and returned home in safety after spending some eight weeks in the Kara Sea. This voyage was followed by several others, and in 1880, and again in 1895, Captain Wiggins read very interesting papers, describing his discoveries before the Royal Society of Arts.

The work of which Captain Wiggins was the pioneer has now been taken over by Mr Jonas Lied, of the Siberian Steamship Manufacturing and Trading Company He has taken out vessels for three years in succession, but the last expedition of the "Haugastoel" and the "Eden" point to further and more important developments. Owing to the Siberian Railway having been taken over by the Russian Government exclusively for war purposes, an outlet for Siberian commerce by sea has become a matter of urgency. As much as 150,000,000 poods of wheat are held back in the interior, and enormous quantities of butter, hemp, flax, linseed, and other raw produce are being stored at great expense. Mr. Lied is already making preparations for another expedition next year on a far larger scale than anything hitherto attempted. He proposes to send out between twenty and thirty ships.

One very important result of this year's enterprise, says the *Times*, has been to establish the possibility of making use of the Obi River as well as the Yenisei. The Obi runs through the most fertile district of Central Siberia. In previous years Mr. Lied left it outside the scope of his operations, owing to the shallowness of the waters which had to be traversed at its mouth to meet the river craft. On experiment, however, this year Mr. Lied found that the difficulties had been exaggerated, and that a steamer of 3,100 tons was able to take a full cargo there. The Yenisei needs, to bring produce down to its mouth, a much larger fleet of river boats, the expense of which, in view of the war, the Russian Government is unwilling to incur. The present boats, about forty in number, are sufficient only to charge two or three sea-going steamers. On the Obi, however, there are 350 river steamers and 650 barges, with a capacity of up to 3,000 tons each. This fleet is capable of bringing down 500,000 tons of goods a year.

Increased experience of the Kara Sea route has resulted in a marked shortening of the time taken by the voyage. In 1913 the "Correct" was twenty-three days on the way from Tromsö in the north of Norway, the last port of call, to the Yenisei. This year the voyage both there and back was accomplished in nineteen days. The main difficulty in the past has been the prevalence of ice in the Kara Sea, and it has been overcome by the use of wireless telegraphy, as was explained in an article in the *Journal* of December 12th, 1913 (p. 79). The Russian Government has erected three wireless stations in this region, which correspond with a station at Archangel. The first two stations command the two straits which give entrance to the Kara Sea, and approaching vessels can be informed by wireless which strait is freer from ice and what are the conditions beyond.

Mr. Lied considers that it is now possible to guarantee a through passage every year "Central Siberia," he adds, "is the richest country one can imagine. It only wants communications. English people, I think, hardly realise what the resources of Siberia are. I daresay they will be surprised to hear that it has populous cities- Omsk, Tomsk, and Irkutsk, each with 130,000 inhabitants or more—where you will find people going to the theatre in evening dress."

ENGINEERING NOTES.

Artistic Bridge Building in America —The bridge recently completed at South Bend, Indiana, across the St. Joseph River, from Leeper Park on the south side to the north shore drive, was designed with special attention to external appearance because of its location. Bedford stone, smooth finished and laid in non-staining cement mortar, was used for facing the entire bridge and for the handrail. An elliptical curve was adopted for each of the three arch spans of small rise, and the resulting outlines give a very satisfactory appearance. Work was begun on this bridge on August 20th, 1914, and just about five months later street car tracks were laid, and practically all the construction, except sidewalks and paving, had been completed. The structure is 300 ft. long and 70 ft. wide between spandrel walls, and contains approximately 7,000 cubic yards of concrete. The foundation soil consisted of sand, gravel, clay, and quicksand in the various locations, hence it was necessary to drive piles from 25 ft. to 35 ft. long about 4 ft. on centres under all piers and abutments, in order to eliminate any danger from washing out of the quicksand at the foundation of the south pier; the 18 ft. steel piling used for the coffer dam was driven down to a point 12 ft. below the footing. The centre arch has a clear opening of 116 ft. and a rise of 16 ft. 8 in., or about one-

seventh of the span; the two side arches are 80 ft. clear span and 14 ft. 6 in. rise. The flatness of these arches was decreased by using a roadway grade line on a vertical curve, with a rise of 4 ft. at the centre of the bridge. The piers are 12 ft. wide and 87 ft. long, and extend 16 ft. below the springing lines of the arches. They were designed to withstand the unbalanced load of the longer arch, by making the footing 6 ft. wider on the side opposite the large arch. The solid arch ring of the 116-ft. span is 2 ft. 4 in. thick at the crown, 4 ft. at the haunches, and 8 ft. 6 in. at the piers; the arch rings for the 80 ft. side spans are 1 ft. 10 in. thick at the crown, 3 ft. 3 in. at the haunches, and 6 ft. 6 in. at the abutments. These arch rings are reinforced at both intrados and extrados with deformed bars spaced 12 in. on centres and extending well into the piers and abutments. Lacing bars of ½-in. rods connect the main bars, which are also tied together by ½-in. rods running at right angles to them and spaced about 1 ft. apart. The spandrel walls were built of concrete, reinforced with ⅞th bars, and placed behind the Bedford stone facing already mentioned. After the stones were laid up they were coated on the back with a heavy coat of waterproofing, including a second coat of asphaltic paint, special care being used at the joints. The same treatment was given to the back of the arch rings and the spandrel walls, and no discolouring whatever has developed. The arch rings were designed for a live load of 300 lb. per square foot over approximately one-half of the span; the line of pressure for this loading was found by the elastic theory to be within the middle third of the joints for the entire arch. The dead load was assumed at 150 lb. per cubic foot for concrete, 100 lb. per cubic foot for earth embankment, and a 100 lb. per square foot for the pavement. Concrete, composed of 1:2½.4 mixture of Portland cement, washed sand, and crushed stone, was used for the arch rings, and for the piers, abutments, and spandrel walls, the proportions were 1:3 5. The contract price for the bridge was £20,500. The above details have been abridged from the *Engineering Record* of New York.

Oil and Concrete.—It is reported that the Director of the United States Office of Public Roads has found that concrete may be made damp-proof by mixing mineral oil with the materials, and that the presence of the oil does not reduce the tensile strength or substantially lessen the compressive strength. The oil is added to the matrix after the latter has been well mixed, and after thorough incorporation traces of the oil disappear—where is not stated. Perhaps this disappearance is the explanation of the apparent anomaly, and the concrete maintains its normal strength in spite of the oil, deriving some compensation from the additional mixing. That the admixture of oil would tend to oppose the passage of moisture is not surprising, but it is strange that the strength of the mass should not, at the same time, be lessened. The addition of the oil seems to delay the setting of the concrete, but not the rate of increase in strength.

A New Steel Plant in Australia.—On April 2nd, in Engineering Notes, we remarked on the first manufacture of steel in Australia. The operations began recently by the "blowing in" of a 350-ton blast furnace. One blast furnace, three open-hearth furnaces, and a combination structural steel and rail mill have been completed, and sixty by-product coke ovens are under construction, at Newcastle, New South Wales. The plant owned and operated by the Broken Hill Proprietar (Limited) of Australia, which company controls large iron-ore deposits in South Australia. The expert steel workers have been brought from various steel centres in the United States, and are, in general, under a three years' contract.

The Manufacture of Patent Fuel.—An important industry of South Wales that has made great progress during recent years, we hear from a correspondent of the *Times*, is the manufacture of patent fuel. This substance, known on the Continent as briquettes, has hitherto been composed chiefly of small coal, with a binding agent, usually pitch, made into blocks of various sizes and shapes. The magnitude of the industry may be gauged from the fact that in Germany over 20,000,000 tons per annum are produced, while in France, also, there is a very large output. This country as yet ranks third with less than 2,000,000 tons per annum, made chiefly in South Wales. The production in the last few years has, however, more than doubled. While possessing many advantages, patent fuel has had to contend with one great obstacle to its use as a naval fuel. The mixture of pitch causes it to give off considerable quantities of smoke, and for many years experiments have been made to find a binding substitute that would make the resulting fuel as smokeless as the best Welsh coal, without reducing its high efficiency. For this purpose, flour, glucose, molasses, and many other substances have been tried with only partial success. During the last eighteen months, however, some important experiments have been carried on under the control of Mr. D. A. Thomas in conjunction with Mr. H. J. Phillips. The system is to produce blocks of nothing but pure coal by forming, under very great pressure, powdered coal into blocks of suitable size and shape. It is claimed that the blocks thus made are weatherproof and are not more smoky than coal. It is understood that steps are being taken to establish works in South Wales to manufacture this new class of patent fuel on a commercial scale.

Engineering Representation Abroad.—In a paper contributed to the Institution of Electrical Engineers, Mr. Pollard Digby, in reviewing the

question of commercial warfare which must ensue on the attainment of military victory, makes a plea for scientific and technical commissioners. After the war capital will be very scarce, and exports of capital in the form of, say, engineering machinery and railway plants to neutral markets will probably be on a greatly reduced scale. The loss of food-getters will impose on the remainder of the community concerned the necessity of greater efficiency of production or of longer hours at the desk, foundry, lathe, and loom. Possibly it will involve both. The organisation of industry, particularly with reference to oversea markets, is important and the better the industrial organisation of any manufacturing nation, the sooner will be the recovery from the aftermath of the war. In many things before the war Germany did a great deal which we would have done well to emulate. Trade Commissioners and commercial attachés have been appointed, and it is with no idea of belittling the useful work that they have done that the author urges the selection of an entirely new type of official representatives to perform the duties of Technical Commissioners. They should be specialists acquainted with the needs of distinct industries and possess the necessary gifts of tact and literary expression. The professional status of a Technical Commissioner, say, in engineering, should be at least the equivalent of full membership of one or more of the institutions most closely concerned in his work. Before proceeding to take up his post, the newly appointed Technical Commissioner should have ample opportunity of conference with representatives of the industry concerned with his sphere of work, both as regards their selling and their technical departments, and methods of manufacture. At stated intervals he should return to England to confer with those concerned in his work. Mere exhibitions of German articles in London with particulars of the wholesale and retail prices, though good in their way, will not suffice. We need representatives with technical experience and foresight, studying conditions in the markets which we seek to supply.

Electric Car Heaters for Cold Weather Concreting. By putting electric car heaters to the novel use of warming concrete during construction in cold weather, the Salt Lake and Ogden Railway was able to complete over half a mile of street track last season. The work consisted primarily of 7-in. 80-lb. T-rails on box girder sleepers supported by a concrete base. The concrete was poured through chutes direct from the mixer to the track. Electric car heaters were then installed at intervals of 10 ft., and connected ten in series on a 720-volt circuit. Canvas was stretched over the green concrete, and the heaters were placed in circuit with the trolley wire by means of a fishpole connection. In this way the entire mass was kept warm until the concrete had set.

OBITUARY.

CONRAD THEODOR VAN DEVENTER.—The Netherlands statesman, Dr. C. Th. van Deventer, who died on September 27th, was well known in Anglo-Indian circles, and took a great interest in British colonial developments. He had been a member of the Royal Society of Arts since 1909, and, before the war, he had promised to read before the Society a paper on the Dutch Colonies.

At the age of eighteen he entered Leiden University and in 1879 became a doctor of law, after writing a dissertation on the question: "Are our Colonies, according to our Constitution, part of the Realm?" In this same year he went to Delft, to qualify for the Dutch Indian Civil Service; in 1880, at the age of twenty-three, he passed the required examination, and went out to Java

After a couple of years' service as clerk to a court of justice, he entered a firm of lawyers and made his fortune, returning to Holland in 1897. It proves his versatility that, upon his return to the Netherlands he became the musical correspondent of a Netherlands-Indian paper. This, and the writing of numerous able and lucid articles on colonial subjects for leading Netherland reviews and papers, fully occupied his time, and in addition he became one of the editors of the Netherlands monthly review, *De Gids*.

In 1904 the Netherlands Minister of the Colonies invited him to prepare and write a report on "The Economical Condition of the Native Population of Java and Madura," and for this work a knighthood of the Order of the Netherlands Lion was conferred on him.

In 1905 he was elected a member of the Second (popular) Chamber of the States-General, but lost his seat at the General Election of 1909. In 1910 the Government sent him to Brussels as chairman of the select committee representing the Netherlands colonies at the exhibition. In 1911 he was elected a member of the First (upper) Chamber of the States-General; in 1912 he revisited the Netherlands East Indies and travelled all over the colonies; and in 1913 he was again elected a member of the Second Chamber.

A remarkable part of van Deventer's labours on behalf of the native population was connected with the Kartini schools. Kartini was a Javanese princess, who received the usual training and education of an Oriental girl of such high rank. This, however, did not satisfy her, and when still in her teens she found ways and means to educate herself and emancipate her mind from the traditional Oriental conventionalities. She then wrote a book, in which she explained what had moved her, and expressed the hope that it might be possible to do for other Javanese girls and women what she had succeeded in doing for herself. She came into touch with leading Netherlands personalities, van Deventer being one of them, and

he became the chief organiser of the Kartini Foundation, which by donations and annual subscriptions establishes and runs the Kartini schools for Javanese girls.

GENERAL NOTES.

THE WORLD'S POTASH.—The potash hitherto used in this country has been chiefly derived from the enormous deposits of potash salts which occur near Stassfurt, in the north of Germany. These deposits have been systematically and economically worked, and the trade was so well organised, that German potash, on account of its cheapness, became the almost exclusive source of the potash required throughout the world. The German source being no longer available, it has become necessary to take stock of other sources of supply, and these are considered in "The World's Supply of Potash," a pamphlet just issued by the Imperial Institute. In this pamphlet—which forms, in fact, a miniature encyclopædia of its subject—both the old and new sources of potash are described so far as details are available. Certain of those will probably only be utilised so long as the price of potash continues high, but others promise to become active competitors with the Stassfurt deposits, even when prices again fall to their usual level. The chief use of potash, usually in the form of chloride or sulphate, is as an artificial manure, for which purpose over 90 per cent. of the world's output is employed. But potash is also essential for numerous chemical industries carried on in this country, and for the manufacture of the finest kinds of glass, and the present scarcity is having considerable effects on these industries. The increased production of potash in the United Kingdom from kelp and other vegetable sources, referred to in this pamphlet, is now under serious consideration.—*Engineering.*

INDIAN MICA.—The Hazaribagh district is one of the most valuable mica-producing areas in the world. Except for a very small amount from Sweden, all the "ruby" mica comes from Chota Nagpur, and India yields more than half the world's output of mica generally. The country where it is found is of a jungly nature, and this renders observation of the prospecting coolies a difficult matter. These coolies scoop away the earth and find the mica generally at a comparatively small depth from the surface. It is then in irregular lumps, usually not more than 12 to 15 in. long and 6 or 8 in. thick. This is split into scales or laminae. Large sheets are the most valuable, and a piece 30 in. square would probably fetch 100 rupees. When split up into sheets it is classified according to size and packed in what are known as books. It is then ready for export. According to the *Pioneer Mail*, however, it is very seldom that a large sheet finds its way to the owners of the land on which it is found. The coolie usually hides it in the ground, and subsequently sells it to an agent. The nearest parallel to what occurs is found in illicit diamond buying in Kimberley and other parts of South Africa. Although the expenses incurred in working mica are extraordinarily small, the business does not pay if no large "books" are obtained. Consequently, if a firm is consistently being robbed of its best finds it naturally fails, and this is the reason for the failure of so many firms.

BUSINESS WITH ITALY.—The *British Export Gazette*, in a recent article, reviews the present and past position of Italy in regard to trade with Great Britain and with the Central Powers, pointing out that the entrance of Italy into the war is Great Britain's opportunity to regain lost trade with this country. To-day, says the *British Export Gazette*, Italy finds herself obliged to seek new sources of supply for goods to the extent of £35,000,000 annually, hitherto obtained from the two Teutonic Empires, and to find new markets for produce and manufactured goods to the amount of £22,000,000. Germany had obtained almost complete control over Italian banking and financial institutions, as, indeed, over almost every industrial and commercial activity. In Italy the feeling is very strong that the bulk of the manufactured goods required should be purchased from the United Kingdom, and the latter encouraged to enjoy once again the very large share of the trade formerly held; but the attention received from the German firms must be accorded by British firms also if business is to be done. German catalogues and price lists were sent printed in Italian, with decimal coinage, weights and measures, and correspondence from Germany was conducted in the Italian language, requests for further information were immediately replied to, and all orders taken or given were executed with promptness, while German commercial travellers penetrated even to the remote country districts. Now that Italy has entered into the conflict, she will not be requiring for ordinary domestic consumption all that she required while she remained neutral; it is rather the future that is to be prepared for, the shaping of things now, in view of developments after the war; the market should be wooed and appropriated as far as possible, the probability being that when peace is signed the prejudice against everything Teutonic will remain bitter for years, and German goods will not be bought in Italy if the same class can be obtained from other countries.

CANADIAN COPPER FOR SHELLS.—It is announced in Ottawa that arrangements have been completed under which, for the first time, zinc and copper required for the manufacture of shells will be both produced and refined in Canada. Hitherto Canadian manufacturers have depended entirely for their supply of these materials upon American manufacturers.

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All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICE.

EXAMINATIONS IN ENGLISH FOR BELGIAN REFUGEES.

In response to several applications, the Council have decided to hold an examination in the English language for Belgian refugees, provided a sufficient number of candidates enter. The paper would be specially adapted to the needs of foreigners, for whom the present examination in English is obviously unsuited.

It is proposed that there should be an Elementary paper, and also, if a sufficient response is made, one in the Intermediate Stage. It appears improbable that there will be many candidates capable of taking an Advanced Stage paper, but if a sufficient number apply one may be set in this stage also.

It is proposed that the examination should be held, under the usual conditions, either in the April Examinations (April 10th–19th), or in the May—June Examinations (May 29th—June 7th).

Intending candidates should apply to the Secretary of any of the Society's local Examination Committees. A list of these can be obtained at the Society's House.

SCIENCE IN THE WAR AND AFTER THE WAR.*

Turning to the applications of science in the war, we can mention four chief departments of it under the headings chemical, mechanical, electrical, and physical, which cover such appliances as high explosives, aeroplanes and dirigibles, submarines, wireless telegraphy, and range-finders. I shall not attempt to discuss the details of a fraction of all these applications, but just touch briefly on two departments which happen to have occupied my own attention during the vacation, viz., range-finders and wireless telegraphy from aeroplanes.

An extremely important matter in all war with projectiles is to ascertain the exact distance of the objective, whether it be ship or gun or building. The range of the projectile depends on the angle of elevation of the gun and the character of the ammunition and several other factors.

The proper setting of the gun can, of course, be determined by trial shots, but the larger the gun the more expensive this process and the more necessary not to let the enemy know anything until a shot or shell falls exactly where it can do most damage to him.

Range-finders have for their object to determine this distance by some optical appliance. They are divided into two classes: first, prism, or base range-finders, and, secondly, subtend range-finders. We can explain the principle of these by reference to our eyes and the method by which we roughly judge the distance of an object. When we look at an object the optic axes of the eyes converge on it, and by long practice we are able to appreciate the inclination of the axes. The centres of the eyes are about $2\frac{1}{2}$ in. apart. Hence we have a very short-based isosceles triangle, but we are enabled by our muscular sense to give a rough guess as to the angles at the base, and practically to infer something about the length of the triangle. Again, we do it in another way by estimating the relative sizes of the image of known objects, such as a man or house or other thing which is formed on the retina. Another thing which assists us is the amount of detail we see in the object looked at.

The range-finders used in war are only more exact applications of the same principles. One of the most accurate is that of Professors Barr and Stroud. This is a base or prism range-finder. It consists of a tube varying from half a metre to two metres, about 6 ft. in length. At the ends of this tube are two totally reflecting prisms, which receive rays from the object and send them down the tube. At each end of the tube is an object glass, which forms an image which is received on a peculiarly cut prism at the centre and by an eye-piece. The arrangement virtually forms a sort of double telescope corresponding to two eyes set 6 ft. apart. When the observer looks into the right eye-piece he sees a field of view which is divided into two parts, one produced by light coming into one object glass, and the other by that coming

* Extracted from the introductory lecture delivered at University College, London, on October 6th, by Professor J. A. Fleming, F.R.S.

in at the other. If the object seen is a mast, say, of a ship, it appears broken in two parts. The observer can rectify or bring into agreement these two parts of the image by moving to or fro in the tube a thin prism. The position of this prism is read off on a scale seen with the left eye-piece. This scale shows the distance in yards of the object.

Thus on board our battleships a range-finder of this kind is placed in one of the fighting-tops on the masts, and the observer looking at a distant ship can in a few seconds move the prism, adjust the two parts of the image to agreement, and read off the range. He then sends down the range by telephone to the gun-layers. Thus in the battle of the Dogger Bank, and in that of the Falkland Islands, firing by our battleships began at about 17,000 or 18,000 yards. The range-finder would thus be continually sending down the ranges 20,000, 19,000, 18,000 yards, etc., and the gunners would keep the object vessel in sight and fire when the command was given as the known range of hitting was reached.

The same principle is applied in a smaller instrument for military use, called the Marindin range-finder, invented by Major Marindin, only in the latter instrument the means adopted for bringing the two parts of the field of view or image into agreement are by a movement of one of the prisms.

The Barr and Stroud range-finder is a very accurate instrument, and will determine ranges up to 20,000 yards, or about 12 miles, with an accuracy of 50 to 100 yards.

In the next place there are range-finders called subtend range-finders, which depend on the measurement of the size of an image of a known object. When we look at an object either with the eye or with a telescope at different distances, it appears to be smaller the farther away we are from it. In the case of the eye we have no means of measuring accurately this variation in size except by comparing the apparent size of the distant object with some near object the size of which is known. Hence judging distance by the eye requires long training, as all sportsmen, sailors, and travellers know.

Moreover, we are apt to be deceived as to the apparent size. Ask anyone, for instance: How large appears the full moon? Many people would say, As large as a shilling—meaning that it has the same apparent angular magnitude as a shilling seen at 10 in. or 1 ft., which is the usual distance we hold a book or paper when reading.

But now, if you try the experiment, you will find that the full moon is covered by a very small pencil, like a pocket-book or dance-programme pencil, held at 10 in. from the eye. In scientific language, the apparent size of the moon is about half a degree, which means that it is covered by an object $\frac{1}{10}$th in. in diameter held 1 ft. from the eye.

A man 6 ft. high would subtend the same angle at a distance of 720 ft. Hence you can tell the distance of a man by ascertaining the distance at which an object of known size, say a pencil, must be held so as just to cover his height. An ordinary pencil $\frac{1}{4}$ in. in diameter held horizontally at arm's length (= 2 ft.) would just cover a man 5 ft. 8 in. high at a distance of 544 ft., or 181 yards. The subtend range-finder works on the principle of measuring the angular magnitude of the object. One way of doing this is to place in the focus of the eye-piece a plate of glass with divisions ruled on it with a diamond. If we know how many divisions are covered by an object of known height at a known distance, we can tell the distance of any other object of known height.

It is very seldom, however, that we do know the exact height of the object, and, moreover, it is very difficult to count up accurately many very small divisions ruled on glass when the object seen is at all dark.

During the vacation I have been turning attention to methods for overcoming some of these difficulties. As these inventions are being submitted to the Ministry of Munitions, I do not think it desirable to go into details as to the methods, but I will tell you the results. I have invented three forms of range-finder—one which is an improved subtend range-finder with which I can find the distance of any object the dimensions of which are known, whether height or width, or any part of it. Also I have invented methods for using two such instruments to measure the distance of objects the dimensions of which are not known. In the second place, I have invented a simple form of base range-finder which measures what is called in astronomy the parallax of any distant object, and hence determines its distance. In the third place, I have devised a simple form of depression or elevation angle meter by means of which the height of any hill, and also the distance of any object from it, or from an elevated position, can be determined by an observer standing at the top of the hill, provided that he can also see two marks placed at the base in line with the point of observation on the hill and at a known distance apart. These instruments are simple and inexpensive to construct, and give an accuracy of measurement quite sufficient to direct rifle or artillery fire or bomb throwing in trenches. One great advantage of my range-finder is that it can be used with a periscope from the bottom of a trench so that the observer need not be exposed at all, but can determine the distance of the enemy's trench by observation on any post of a wire entanglement or stick or rock or anything with a sharp outline. Another principle which may be applied in making a range-finder, which I have also done in my instruments, is to observe the variation in the size of an object as seen in a small telescope by moving away from it a certain distance. Thus, suppose that a man was seen at a distance of 200 yards, or 600 ft., then his apparent height would be covered by the width of a pencil held about 2 ft. from the eye. Suppose the observer were to approach to half that distance or move in 300 ft., then the apparent size of the man would be doubled. If, however, the man were a mile

away, then moving towards him 100 yards would only increase his apparent height by about 6 per cent. Hence we can determine the distance of an object by finding out how much the apparent size is increased when we move in towards it 100 yards or any assigned distance.

Another marvellous application of science in war is that of wireless telegraphy in connection with aeroplanes and airships as a means of scouting and rapid communication of intelligence.

The difficulties connected with it are, however, considerable, and it has greater limitations than the uninitiated would suppose.

In the case of aeroplanes the first of these is the weight of the apparatus. The military aeroplane is already loaded to its fullest extent. In addition to the pilot and observer and the bomb ammunition, it carries in nearly all cases some gun equipment. Hence any wireless apparatus must be made as light and compact as possible. A wireless transmitter of the so-called spark type involves three elements: (i) some source of electromotive force such as a battery or dynamo, (ii) an induction coil or transformer for creating a high electric potential or pressure, and (iii) some form of condenser or Leyden jar which is charged and then discharged across a spark gap, thus creating rapid movements of electricity called electric oscillations. These oscillations are then caused to create others in a long wire called the aerial wire.

In the case of aeroplanes and airships the source of electromotive force is generally a small dynamo or alternator, which is coupled to the engine, and the voltage or pressure is raised to 30,000 volts or so by a small transformer sealed up in oil in a box. The condenser consists of metal plates sandwiched between sheets of glass or ebonite, and the spark balls between which the spark passes are also enclosed. The weight of the whole apparatus has to be kept below 100 lb., and such apparatus has been designed having a weight of not more than 30 lb. The French use a set weighing about 70 lb. One of the difficulties is to dispose the aerial wire conveniently and safely. It is sometimes made of aluminium and stretched on insulators carried by light supports on the wings, but the difficulty is to obtain in this way sufficient length. One plan adopted is to coil the wire on a reel, which the observer can uncoil and let it float out behind the aeroplane.

The wire must be connected to the reel by a safety catch so as to be released at once if it catches in trees or buildings. By this means an aerial wire of 100 ft. in length can be employed. The observer has near his hand a key by which he controls the spark discharges and so sets up in the aerial wire groups of electric oscillations which create electric waves in the æther, and signal the message in Morse code.

In this manner there is not much difficulty in equipping aeroplanes with transmitters which will send messages thirty miles or so to a corresponding earth station.

These latter are the military portable motor-car or pack stations, the details of which were described in a lecture given here last year on "Wireless Telegraphy in War."

The receiving arrangements used on aeroplanes comprise a head telephone which is worn by the observer associated with some simple form of detector such as a carborundum crystal, aided by which the observer hears the signals sent to him in Morse code as long and short sounds in the telephone.

The noise of the aeroplane engine and that of the rush of air renders this method of aural reception a matter of great difficulty, especially as the messages must be sent in secret code, and the observer must therefore hear every letter distinctly if the message is to be intelligible. Great efforts have been made to devise methods of reception which shall appeal to the eye by a visual signal rather than to the ear, but the exceedingly small electric currents set up in the aerial wire by the arriving waves make this a matter of extreme difficulty, and the problem has not yet been completely solved. There is then the difficulty caused by "jamming." If the signals from an aeroplane are picked up by a hostile station, this latter at once sends out powerful but unmeaning signals, the object of which is to blur and drown out the reception or sending of signals by this aeroplane. Moreover, the sending of wireless signals by an aeroplane reveals its presence to hostile earth stations before it can be seen by the eye.

Hence, wireless telegraphy may be a means of revealing the enemy's scouts, and it involves a certain kind of war in the æther as well as war in the air.

In the case of airships there are other difficulties as well, and it is interesting to note that there are special difficulties in connection with Zeppelins. These aerial monsters are, as everyone knows, constructed with a framework of aluminium, containing in its interior the eighteen or twenty balloons inflated with hydrogen. Now as we rise upwards in the air the electric potential increases rapidly, and if a conducting body at a height gives off water drops or products of combustion, it is rapidly brought to the potential of the air at the place where it is. In the case of Zeppelins this equalisation is no doubt brought about by the escape of products of combustion produced by the engines. When the conducting body is brought down suddenly to earth again, there may be a great difference of potential between it and the objects on the earth. If it is a good conductor, a spark may pass, and if it is, as in the case of a Zeppelin, a conducting body containing a highly inflammable gas, leakage of which cannot altogether be prevented, this spark may cause an explosion and destruction of the airship. Again, the violent electric oscillations created in all metal objects near powerful radiotelegraphic apparatus may cause sparks to jump between metal parts, and hence may inflame a hydrogen leak.

It has therefore been recognised that there are special electrical difficulties in connection with the

working of wireless on rigid airships with metal frames and also in connection with the use of spark apparatus. However carefully the actual working spark is enclosed there is always risk of induced sparks.

There is room yet, therefore, for much research and experimenting in connection with the use of wireless telegraphy on aeroplanes and airships, and the practical problems are by no means completely solved.

This leads to the consideration of the methods we have adopted for dealing with these and all other suggestions of the same kind of the nature of war inventions.

The Royal Society appointed certain committees at an early stage in the war to deal with engineering or mechanical and with chemical inventions. These committees were constituted secret committees, and none of the Fellows, except the council and the small number of the appointed Fellows, were allowed even to know the names of the members. The ostensible reason for this unusual secrecy was that the committees should not be inundated with correspondence from eager inventors and that their work was confidential; but this argument is scarcely valid, because the names of the members of other inventions committees, such as those afterwards appointed by the Admiralty and the Ministry of Munitions, were made public. The publication of the names of members in no way necessitates the publication of information as to their work. In the formation of such committees the important qualification should be not merely scientific or theoretical learning, but sufficient practical knowledge of the matters considered.

The men whose opinions are valuable on war inventions are the men who have to use them, namely, experienced military and naval officers. Again, the value of an invention can usually only be estimated by a practical trial, and this means expenditure. It is an almost impossible matter to judge of an invention merely from a written description. An idea may be old or a method may be familiar, and yet it may be carried out in detail in such a manner as to have great practical value under certain conditions. The ability to form a correct judgment of an engineering invention requires a very wide experience, since it is not easy to appreciate the good points or anticipate the defects of an invention or suggestion or idea which has not been put to the test of practice. Nevertheless, the experts appointed by the Ministry of Munitions are doing valuable work in sifting out the useful ideas from the hundreds already submitted to them.

It is beyond any doubt that this war is a war of engineers and chemists quite as much as of soldiers.

The 42-cm. Krupp gun which smashed in a few days the fortifications of Liége, Namur, and Antwerp, which were confidently expected to hold out for months, is only a piece of heavy engineering. The complete gun weighs 87 tons, and the foundations or carriage 37 tons. Two hundred men are necessary to erect and work each gun, which requires twelve railway waggons for its transport and is composed of 172 parts. It takes twenty-five to twenty-six hours to erect in place. The projectile or shell weighs 8 cwt., and is 5 ft. 4 in. long and 16½ in. diameter. It is fired electrically from a distance of about a quarter of a mile, and each shot costs £550. The range at which the Liége forts were destroyed was fourteen miles. The mere transport and erection of this gun, let alone its manufacture, demands engineering knowledge of a special kind. It is the same with smaller arms. The rifle, except as a support for a bayonet, has almost become obsolete in face of the machine-gun.

To win this war we have to achieve engineering feats. The mammoth howitzer, the great armoured triple-engined aeroplane, and the quick-firing machine-guns are all products of the engineer's workshop, and the pivot round which all Germany's maleficent power turns is Krupp's works at Essen, and the chemical and ammunition factories in Westphalia. The knock out blow will be given at those points, and they must be reached through the air if trench work proves too slow.

But in addition to the concentration of engineering knowledge and skill on the problems of the war, we have to think as well of what will come after. What is required is not merely opinions on inventions already made, but the proper organisation of inventive power and scientific research to bring about new and useful results. This is only to be achieved by bringing to bear adequate combined inventive or scientific power on definite problems which are not too far removed from practical possibilities.

We have as yet made scarcely any progress in the creation of a disciplined army of scientific workers which shall embrace all the abilities in the Empire. We are still in the stage which by comparison with an army is that of a mob of civilians equipped for war with shot guns and sticks.

One reason for this, I think, is because our chief scientific body, the Royal Society, has not taken upon itself more the function of guiding and assisting the general direction of research and invention.

The real function of the Royal Society should be to organise, direct, influence, assist, and promote scientific research, and to do it by an efficient organisation embracing the whole of its Fellows. It represents, or should represent, the very best ability in all departments of scientific knowledge, and it should be organised into grand committees of subjects, as suggested by Professor Armstrong, on one or more of which every Fellow should have his place. The work of these grand committees should be to guide and instigate research in their own departments, to organise general discussions on leading questions in the manner undertaken of late years by the British Association, and to help to direct towards common and important ends the powers of scientific investigation in our universities and colleges.

The special and technical societies provide the facilities required for the reading of papers. A paper on physics, chemistry, or engineering as a rule receives better discussion and criticism if read at the Physical, Chemical, or Engineering Societies than at the Royal Society, and the discussion on a paper, if proper time and notice are given, is often quite as valuable as the paper itself. Although the individualistic method of research in which each scientific worker takes up whatever kind of research he pleases has produced good results in the past and is in agreement with our national characteristics, it is a serious question whether we shall not have to put limits to it in the future. The problems which await solution require in many cases combined or co operative research. One of the most useful improvements in the proceedings of our learned societies would be the devotion of more time to well-organised and predetermined subjects of debate with the object of advancing knowledge at the boundaries of cognate sciences.

This applies to the purely scientific problems, as well as to the problems of industrial research. It must be remembered that, after this war is over in a military sense, we shall immediately commence another war of a different kind, in which the weapons will not be bullets and shells, but our national powers of invention, scientific research, commercial organisation, manufacturing capabilities, and education, and these will be pitted against those of a highly organised Germany determined to win back in commerce by any and every means, fair or foul, that which has been lost in war.

That commercial and industrial war will be waged by our enemies with the same ruthlessness and neglect of all scruples as their military operations. We have said good-bye now and for ever to those easy-going amateur British methods which have held us in the past. What we require is to obtain a higher percentage efficiency in all our operations. We have to attain larger and better results in education, scientific research, and industrial work to increase our national output in every way.

We have been buying dyes, chemicals, optical instruments, and drugs from Germany, glass from Austria, arc-light carbons, electric machinery, and a hundred other things we have no need to buy, and the reason is that we have been shirking the effort and research necessary to make them as cheaply or as well at home. But the England with a national debt of 2,000 to 3,000 millions sterling will be a different kind of place to live in from the England of the year before last, and we shall have to adapt ourselves to the new conditions by new methods of work.

One of the most important of these, I venture to think, is the extension of co-operative research, both scientific and industrial. In the case of industrial work manufacturers are afraid of making their wants and difficulties known, lest the mere statement of them should enable a British rival to find a solution and get ahead. It is necessary to appreciate, however, that rivalry between British manufacturers is not nearly such a serious matter as the competition of Germany with all of them will become, and that British manufacturers will have to stand shoulder to shoulder to meet the common foe. German firms do not hesitate to pool their knowledge if it enables Germany to get ahead of other nations, and British trades will therefore have to meet this organisation by one of a similar kind. In the same manner I have long been convinced that far greater advances might be made in purely scientific research in many departments of knowledge if we were to adopt more extensively the custom of associated work. I mean by this the formation of committees of workers, not too large for expeditious decisions, but charged with the duty of investigating certain formulated problems. It is in this respect that our learned societies might do so much more than they do. The proceedings of these societies are mostly a record of isolated, disconnected pieces of work of very different scientific value. But if properly organised discussion were brought to bear on the question, it would be possible to induce investigators of reputation and ability to associate themselves more in conjoint work to the great advantage of our common knowledge. The learned societies should therefore fulfil to the adult and experienced investigator the same function which the professor or teacher should fulfil to his research students, viz., supply them with suggestions for lines of research to stimulate thought and invention.

It is quite certain that we shall have to organise in this way to a far higher degree than we have yet done what may be called the strategy of research, and that the learned societies should act in some capacity like the great general staff of an army towards the subordinate generals and corps commanders. We require therefore to get on to the councils of our learned and technical societies, and into their presidential chairs, not merely men eminent for their private researches, but men of large ideas with organising abilities and inspirational power. If we do not do this, then, although by a lavish sacrifice of life and treasure we may win, as we are determined to do, in the military and naval operations, we shall in the long run be hopelessly defeated in that slower but none the less deadly scientific and commercial competition which will follow upon the cessation of actual hostilities.

OPENING SOUTH CHINA COAL FIELDS.

There is a very fair prospect for the development of some of the coal fields of South China, especially within Hong-Kong's trade territory, on a modern basis. At several localities along the West and North Rivers near Canton coal fields have been worked in native fashion for some time, and the output has come to amount to a considerable

volume. A mining expert, reports the United States Consul-General at Hong-Kong, has had occasion to look into one of these fields in the past few weeks, with a view to development along modern lines, and gives some facts of interest. The property examined is situated on the North River, about 160 miles from Canton, the actual mine being located about a mile from the river on the right bank. The survey for the Canton Hankow railway lines crosses the property. The property occupies broken ground, embracing two lines of hills of considerable height. The native workings are located from 800 to 1,000 ft. up the side of one of these ranges, and the seam has been followed down for about 400 ft. The seam ranges about 9 ft. in thickness.

The native method of working is extremely wasteful, and also extremely dangerous, even where the seam is so plainly exposed as it is in the case of the one worked. On this property there are three seams, one about 9 ft. in thickness, the second about 2 ft. in thickness, and the third about 10 ft. in thickness. While, owing to the broken nature of the country, it is impossible to see whether or not there are faults in the seams, the general indications are that there are none.

The region is essentially coal country, the predominating rock is limestone intermixed with layers of sandstone and slates. Millions of tons of coal are actually in sight. The Government analyst in Hong-Kong reports on the analysis of a sample of this coal that 100 parts contain 0·80 per cent. of moisture, 17·60 per cent. of ash, 20·70 per cent. of volatile combustible matter, and 60·90 per cent. of fixed carbon. The percentage of sulphur is placed at 1·2 per cent., and the calorific value is 12,830 British thermal units. The ash is greyish white in colour. The coke is of hard behaviour when burned, and burns with a fairly long flame.

The matter of transportation has been one of the chief factors in opening such mines. The North River, where these coal seams are found, is too shallow for successful water transportation and there is no economical means of transport at this time. It is anticipated, however, that the Canton Hankow railway line will be completed to this district in about two years at the present rate of progress—that is, it can be completed to that point in that time out of the earnings of the portions of the road already completed and in operation. The completion of this line will not only immediately open up this coal field, but it will also make other fields available for the Hong-Kong coal market and for export.

The immediate need of these fields at present is modern machinery and capital for development. The capital needed for the development of the property examined is placed at about $150,000 gold, and apparently this may be taken as representative of various other fields. On the basis of this investment an output of 500 tons of coal per day is indicated.

SPITZBERGEN IN 1914.*

Spitzbergen remains a No Man's Land despite the many acquisitions of land by subjects of more than one nation. Insecurity of tenure and considerable lawlessness are the result of this lack of control, and the economic development of the country is hindered. Among the minerals which occur in Spitzbergen are large quantities of coal, magnetite, and gypsum. Valuable marble is also found. Almost all the mineral-bearing territories on the west have been claimed by different companies, chiefly British: the east is less accessible, but several British claims occur there also. Altogether British subjects claim about 7,000 square miles of territory, on which several mines and quarries have been opened. Americans have the most valuable coal mines, exporting annually large quantites to the north of Norway. It is tertiary coal, but of excellent steam quality. Russian enterprise in Spitzbergen ceased over fifty years ago, when Russian trappers stopped frequenting the land. Lately there have been some small attempts on the part of Russians to acquire mining claims. Swedish activity has always been chiefly centred in exploration, particularly of a geological nature. Norway has a few unimportant mining claims, and a few years ago erected a powerful wireless installation. German claims were never of importance.

Hunting fur-bearing animals is a dying activity, due to the approaching extermination of the game by ruthless hunters. On the west game is now very scarce.

The proximity of Spitzbergen to the British Isles and the mainland of Europe is generally overlooked, owing to the use of Mercator maps. From Norway it is only 400 miles, and it is within fifty hours' steaming by a fast cruiser from our shores. The west coast is remarkably free from ice, even in midwinter, and the winter climate does not preclude the continuance of mining throughout the year. In winter a number of miners are at work on British and American mines.

BRACKEN AS LITTER.†

In view of the present high cost of feeding stuffs, it is necessary that as much as possible of their manurial value should be recovered in the dung. The fact that the ordinary supplies of potash are meanwhile cut off furnishes another reason for preserving manure, especially liquid manure, with great care; liquid manure is rich in potash. In districts, therefore, where straw is scarce, or where it can be profitably fed to stock, farmers and horse-keepers should use for litter any other suitable material that may be available at a reasonable cost. Bracken or "fern" is specially worthy of attention at the present time.

* Abstract of a paper read by R. N. Rudmose Brown, D.Sc., before the Geographical Section of the British Association in Manchester.

† Special leaflet issued by the Board of Agriculture and Fisheries.

"Bracken" possesses considerable value as litter, and in many places it may be obtained for the cost of cutting and carting. Bracken harvested while still green usually contains as much phosphoric acid as straw, and much more nitrogen, but less potash. If exposed to rain throughout the winter a considerable loss of substance is likely to result, although bracken cut in April has been found, on analysis, to have a similar composition to straw.

Bracken possesses a considerable power of absorbing ammonia and urine. To secure the full absorptive effect, however, bracken must be very thoroughly trampled upon by stock.

Dung made from bracken may be expected to be equal in chemical composition to dung made from straw. On the other hand, it takes longer to decompose in the soil, the fibrous woody stem being only slowly attacked. It therefore opens up the soil more, and is for that reason likely to be more useful on a heavy clay than on a light sandy soil. Bracken should be cut and dried in autumn, but where this is impracticable it may be cut and carted during suitable weather throughout the winter months.

ARTS AND CRAFTS.

Stained Glass.—The Medici Gallery is better adapted than most London exhibition buildings for the display of stained glass, as it faces on the open street at right angles to Grafton Street and so gets a good supply of direct light. Now, after two exhibitions of Mr. Louis Davis's glass, it has been housing a little show of the work of several artists, men and women. The point which struck one most forcibly at first sight is one which all those who are contemplating the erection of a stained-glass window will do well to bear in mind—the excellence of the stained glass was almost invariably in inverse ratio to that of the sketches. That this is often the case has, of course, been recognised by experts from time immemorial, but it has not always been realised by the general public—it would, indeed, have been rather strange if it had been. At the Medici Gallery the fact was plain for all the world to see. The visitor looked at the sketches and cartoons, and thought one or two of them rather ugly and others full of promise, and on turning to the glass itself found that his judgment was generally reversed. The reason for this is not far to seek. The artist who conceives his glass as glass with the light shining through it is at a disadvantage when he tries to represent his ideas on paper, whilst the man or woman who thinks first of the design and then sets out to translate it into glass naturally makes a much better job of his drawing, especially if it be a small sketch. Another interesting feature of interest was the number of women exhibitors. Women have for some years now been turning their attention to stained glass design, but this is the first time that the work of so many of them has been shown in London at the same exhibition. In this case the most important glass was shown by a lady worker. Miss Esplin's lights of the Three Wise Men, designed for the clerestory windows in the south transept of Khartoum Cathedral, were the most remarkable and the largest windows on view. They showed a very serious purpose as well as a thorough understanding of the material. The glass is very rich in colour, and on a gloomy autumn day in London it looked rather heavy and sombre, but the quality which makes it difficult to judge in England at this time of year ought to stand it in excellent stead in Africa. It is easy to imagine the window lit up by a tropical sun, as a mass of gorgeous and dazzling colour appropriate both to the portrayal of the Eastern kings and sages and to a southern country. The design of the figures is simple and dignified, and sufficiently un-Western to make the work fit for its position. Amongst the other exhibits, Miss M. A. Rope's two-light window of the Crucifixion was well worth notice, and some of Mr. Reginald Hallward's work was interesting. Mr. George Kruger's designs for domestic windows were distinctive, and Miss Townsend's clever little skit in glass, entitled Fabians at the Forge, and representing Mr. George Bernard Shaw and Mr. Sidney Webb hammering (or attempting to hammer) the world into shape, is the kind of joke that will bear preserving in stained glass. At a time like the present, when many people, unhappily, are considering the advisability of putting up memorial windows, it is a real boon to be able to see the actual work which artists have carried out, and not to be obliged to choose a designer from hearsay or from the usually unsatisfactory evidence of his sketches.

The Design and Industries Association.—The Design and Industries Association has begun in good time to justify its existence by the organisation, in conjunction with certain representatives of the Whitechapel Art Gallery, of an Exhibition of Design and Workmanship in Printing at the gallery in the Whitechapel Road. The association has now a considerable membership, drawn from the ranks of artists, craftsmen, art-masters, distributors, and well-wishers. It is noticeable that since its inception the number of distributors and others who are not artists has considerably increased, and its first exhibition should mark an epoch in its career. It shows, at any rate, the sincerity of the desire on the part of the members to get into touch with trade conditions and to influence industrial production on a large scale, rather than handicraft pure and simple. Mr. Morley Fletcher's speech at the inaugural meeting held earlier in the year raised the hope that the society really had this aim in view, not merely theoretically, but in a broad and practical way, and suggested that some of its members had seen fit to change, or, at any rate, to modify pretty considerably, the opinions which they had formerly held. The exhibition now open leaves no doubt of the committee's intentions. A few examples of finely printed old and modern books, which appeal

(so far as purchasing is concerned) only to the wealthy, are, indeed, shown, but the great majority of the exhibits consists of posters, show-cards, advertisements, wrappers, and such-like things connected with ordinary trade printing. The general effect of the exhibition is admirable, and it made one wonder more than ever why a certain section of the public had been so enamoured of the German and Austrian exhibits collected at the Goldsmiths' Hall. However much the Germans may have excelled in certain lines (the case of books from the Central School of Arts and Crafts contains certainly one book with very attractive German paper sides) their output as a whole, at any rate as represented in England, cannot be said to excel ours, and the present exhibition goes far towards proving it. It covers nearly the whole range of general commercial printing, and should appeal every whit as much to the advertiser and the purely trade printer as to the artist and that larger public more or less interested in art.

Printing at the Whitechapel Art Gallery.—The exhibits at Whitechapel are, of course, mainly British, but it was a pleasure to find amongst them a few well-known posters by Grasset, Chéret, and Toulouse de Lautrec. The copies of Boutet de Monvel's children's books revived many pleasant memories, whilst the cheap topical woodcuts dealing with the war, and in a very different style the fashion illustrations, were well worth looking at The Polish and Russian postcards and illustrated books, too, included some remarkable pieces of colouring.

The posters are naturally the most striking feature of the collection, and they are of peculiar interest because, in the recent Printing Trades exhibitions, this class of work has not been very thoroughly represented. Therefore, although those connected with design and advertisement realised the enormous strides made in poster production within recent years, and though the change in the ideals pursued must have been apparent to all who scanned the hoardings with any attention, there has been little opportunity of seeing the best examples side by side. Here are to be found works by Tony Sarg, Fred Taylor, Norman Keene, Dudley Hardy, William Nicholson, J. Hassall, A. S. Hartrick, George Kruger, and other well-known poster designers. They advertise a great variety of things, but those designed for the Underground form a peculiarly satisfactory group. The Prospect of the River, by Joseph Pennell, Chiswick Mall, by F. Ernest Jackson, and the striking lithograph posters by Frank Brangwyn, suggest that lithography might be used much more effectively than is generally the case over here for poster work. Because thirty years ago bad lithographic work was the fashion, we are not bound to conclude that lithographic posters must inevitably be unsatisfactory. There are only one or two letterpress posters, but they are of such a nature as to show how effective good lettering by itself can be.

The group of gaily and attractively coloured biscuit boxes showed another very practical way in which art may come to the aid of commerce. The cases containing books printed in good type, and border designs and illustrations schemed to form a homogeneous whole with the letterpress, represented adequately the highest type of book production, whilst examples of satisfactory colour-work for book illustrations were not wanting. The publishers' announcements make clear to those who do not already know it, how much the form of advertisements of this type has improved in the last few years. The series of publishers' dust-covers demonstrates the opportunities which design for this kind of work offers to the designer.

At once the most novel and the most satisfactory feature of the exhibition, however, is the courage of its promoters. They have not merely been content to exhibit anything and everything on which they could lay their hands, but they have chosen the objects which in their view illustrate what they have to say, and, whilst confining themselves for the most part to exhibits which they consider commendable, they have not hesitated to include a few instances of bad or inartistic workmanship to show how much less effective it is than equally simple work arranged with some reference to the claims of art. Thus amongst a collection of business lists and catalogues are inserted examples of a good and a bad furniture catalogue placed conveniently close to one another, so that no one can avoid seeing the difference between them and drawing the moral. Certain other exhibits are boldly catalogued as well-designed, and a copy of the harmless but rather poor design which has for years been used for the cover of the National Competition report is exhibited side by side with a suggestion, quite as plain and much more successful, which comes from a provincial school of art. It must be confessed, however, that the problem for the art school has been somewhat simplified by the fact that the designer has not been hampered by being forced to include the official version of the royal G. R. with its accompaniment of the crown, rose, shamrock, and thistle. So many people who go to exhibitions are in need of some sort of guidance to enable them to understand what they are looking at and to grasp why certain objects are put before them, that these few attempts to explain why some of the exhibits are in their places ought to be of very great assistance.

NOTES ON BOOKS.

THE SPIRIT OF THE SOIL. By G. D. Knox. London: Constable & Co., Ltd. 2*s*. 6*d*. net.

Some eighteen months ago Professor W. B. Bottomley read a paper before the Society in which he described various experiments undertaken by him to test the value as a fertiliser of bacterised peat. The paper attracted considerable notice at the time among agricultural and horticultural circles.

Since then Professor Bottomley has been continuing his work, and he read a further paper on the subject at the last meeting of the British Association, which was hailed by several speakers in the subsequent discussion as holding out promises of no little importance.

Briefly, Professor Bottomley's treatment is this. Peat, which has been sterilised by steam, is treated with a mixture of nixtrogen-fixing organisms—*Azotobacter chroococcum* and *Bacillus radicicola*—and after these have been incubated for a few days at 26° C., the peat is ready for use. The bacteria at once proceed to fix nitrogen, and the fertility of the soil is increased.

At a time when the food resources of the Empire, and of these islands in particular, are becoming a subject for more and more anxious thought, it is needless to emphasise the importance of anything that may tend to increase the output of our own lands; and it would also seem that the time is opportune—now that the experts have agreed that Professor Bottomley's methods are to be taken seriously—for a popular explanation of the whole matter. This is the object of Mr. Knox's book. After a preliminary discussion of the nitrate problem and our food supply, he gives a simple account of bacteria and protozoa, and the methods of fixing nitrogen adopted by leguminous plants. From this he passes to bacterised peat, vitamines, and elementary conceptions of chemistry in relation to the soil, and finally to the testing and preparation of humogen, as the bacterised peat is called. Although a popular writer, Mr. Knox has had a sound scientific training, and in spite of its somewhat poetical title, this volume may be relied upon as "an accurate exposition of a new development in agriculture and horticulture, which may have an important bearing on the national food supply."

AN EXPERIMENT IN INDUSTRIAL RESEARCH. Educational Pamphlet No. 30 issued by the Board of Education. By Thomas Lloyd Humberstone. London. H.M. Stationery Office; Wyman & Sons, Ltd. 4*d.*

The experiment described in this pamphlet was devised by the late Professor Robert Kennedy Duncan, of Pittsburgh, and a Fellow of the Royal Society of Arts. Some account of it was published in the *Journal* of September 1st, 1911, in an article entitled "Commerce and the Universities," reprinted from the *Times*; but at a moment like the present, when so much attention is being directed towards the perfection of German methods in organising the relations between research, finance, and manufacture, it may not be out of place to give some further consideration to Professor Duncan's remarkable scheme, which has for its principal object the co-ordination of these three interests.

Like many other people, Dr. Duncan held an opinion anything but favourable of "research" as it was generally carried on in the factories. Chemists were—unfortunately, one can still say are—engaged at miserable salaries, and because no prospects were held out, only inferior men would look at the offers. "95 per cent. of the so-called factory research is worse than loss," said Dr. Duncan, "because the failure makes it impossible for the factory to appreciate the advantage of applied science"

Dr. Duncan then set himself to devise a way whereby well-trained chemists of good academic standing might be attracted to industrial work, and as a result he worked out the scheme of Industrial Fellowships which came into operation in the University of Kansas in 1907, and in Pittsburgh University some three years later. The scheme is thus described by Mr. Humberstone: "A contract is entered into between the manufacturer and the University in which the object of the research is precisely defined. The contract provides that the Fellow selected to conduct the investigation desired shall devote his whole time to the research, with the exception of three hours a week, which he may devote to instructional work in the chemical department. The Fellow is a member of the University . . . and works under the direction of the professor of industrial chemistry, and forwards to the manufacturer periodically, through the professor, reports on the progress of the work. The manufacturer agrees to pay to the University an annual sum for the emoluments of the Fellow during the term of the Fellowship." Clauses in the contract provide for the Fellow's share of profits arising from discoveries, and for the publication of results for the use and benefit of the public.

Mr. Humberstone discusses the conditions of the Fellowship from the point of view of (1) the University; (2) the manufacturer; (3) the Fellow; and (4) the public.

The University gains by the presence of a body of highly-qualified men—many of the Fellows have taken their doctor's degree—enthusiastic as to the value of research and the opportunities for it offered by applied science. The manufacturer has placed at his disposal all the resources of a great institution, with well-equipped laboratories, museums, libraries, etc. He is entirely free from the responsibility of selecting the man best qualified to investigate his problems, and his financial outlay is precisely defined. The Fellow is brought into direct touch with the manufacturer: he works in ideal surroundings, with opportunities of consulting his colleagues who may be engaged upon kindred problems; and his training provides a good chance of securing permanent employment at an adequate salary and with a recognised status. The advantages to the public are obvious, as anything tending to the increased efficiency of industrial organisation must eventually tend to the benefit of the nation.

In the University of Pittsburgh forty-four Industrial Fellowships have been established. They deal with a great variety of subjects, and have already led to a good many practical and valuable results. The emoluments vary considerably—in

some cases they run from £100 to £200 a year; in others the Fellowships are composite, a number of men being engaged on the same problem. Thus, *e.g.*, an exhaustive research is being conducted on the smoke nuisance; a large staff of investigators has been organised, and a sum varying from £2,400 to £3,000 a year has been devoted to the investigation.

Enough has been said, it is hoped, to show that Dr. Duncan's scheme is bold and original. The Board of Education deserve our thanks for printing Mr. Humberstone's lucid account of it, and one trusts that by this means the scheme may be brought to the notice of educational authorities and manufacturers in this country.

THE BRITISH COAL-TAR INDUSTRY. Edited by Walter M. Gardner, M.Sc., F.I.C., Principal of the Bradford Technical College. London: Williams & Norgate. 10*s.* 6*d.* net.

Since the outbreak of the war a great deal of attention has been directed to the manufacture of synthetic dyestuffs, and this not so much on account of its magnitude—the annual value of the dyes used in Britain was not much over £2,000,000—as because our dependence on Germany for these materials threatened our textile trade and other industries, the annual value of which was something like £220,000,000. As a result of this publicity, the story of the coal-tar industry—how it originated with Perkin's fortuitous discovery of the mauve dye, and how it passed into German hands in spite of the fact that most of the raw materials had to be imported from Britain—has become, one might almost say, common knowledge. But although the general outlines are so familiar, the details are exceedingly intricate and the whole matter is of the greatest interest and importance. The success of the Germans in the dyestuffs industry has led to endless ramifications in corresponding directions, *e.g.*, the production of synthetic medicines, photographic drugs and fine chemicals generally, artificial fertilisers, and what is, perhaps, at this moment the most important of all, the manufacture of high explosives on an enormous scale.

In these circumstances it is hardly necessary to insist that it is the duty of those responsible for the future of British industry to make a careful study of the causes which had led to the success of the Germans in these particular lines, and Mr. Gardner's object in compiling this volume has been to present the materials for such a study in a readily accessible form. The book contains the principal lectures and addresses given in this country on the subject since the establishment of the industry by Perkin in 1856 down to the present day. It begins, appropriately enough, with Perkin's Cantor Lectures on "The Aniline or Coal-Tar Colours," which were delivered before the Society in 1868, and it may be interesting to Fellows to note that of all the lectures, etc., reprinted in this volume over one-third have been given in the Society's Great Room.

The result of Mr. Gardner's work is an extremely valuable compilation, which seems to include the *omne scibile* of the coal-tar industry. Incidentally he himself, in an article reprinted from *Nature*, gives, in a very few words, an account of the German dye industry, which explains the secret of its success:—

"The German colour industry is probably the most complicated, most highly developed, and most profitable of all her great industries. The capital invested in it is about £12,000,000, and the German exports of dyes and associated products in 1912 were valued at £10,000,000. The organisation, both for production and for marketing and distribution, is wonderfully efficient, and, above all, the Germans have long realised that in this branch of industry the scientific mind and scientific method must be predominant, not only in the laboratory and in the works, but in the management. The boards of directors of their large works are virtually committees of technical and commercial experts, who are in intimate touch with the respective branches of the works of which they have special knowledge. In a word, the trained man of science has in these works come to his own, and a proper recognition of the necessity of this is vital to the development of the British colour industry."

GENERAL NOTES.

SWINEY LECTURES ON GEOLOGY.—A course of twelve lectures on "Ice and the Ice Age" will be delivered by J. D. Falconer, M.A., D.Sc., F.G.S., F.R.S.E., F.R.G.S., in the lecture theatre of the Victoria and Albert Museum, by permission of the Board of Education. The lectures will be given on Mondays, Tuesdays, and Saturdays, at 3 p.m., beginning Saturday, November 13th, and ending Tuesday, December 7th.

FOREIGN SOAP IN CHINA.—According to the American Consul-General in Hong-Kong, there have already been some notable results as to the substitution of Japanese and other cheap soaps for German and Austrian soaps, formerly forming a great part of the trade. While, of course, certain well-known brands of soap of European manufacture enjoy a prestige in Hong-Kong and its trade territory, which are the natural results of years of trading and advertising, the China soap trade as a whole is a matter of comparative price and quality. Up to two years ago Great Britain had the great bulk of the trade, and she still enjoys the larger share. However, she had lost trade proportionately, while Japan had gained even before the war in Europe interfered with the manufacture and export of soap from that part of the world. With the advent of war the stock of foreign soap was greatly reduced, giving Japanese and Hong-Kong manufacturers a notable advantage; but later there was interference with imports of soda ash from Great Britain, and for a

time it looked as though there would be serious interference with the manufacture of soap in this part of the world. There is more or less difficulty in securing such supplies at present, but apparently those difficulties are less than those experienced by European makers in securing certain other supplies they usually import from other portions of the world.

Road Surfaces in the Federated Malay States.—The Director of Public Works Department, Federated Malay States, reports as follows regarding the bituminous treatment of road surfaces: Extensive trials have been made in Perak, Selangor, and Negri Sembilan with the use of bituminous substances for binding and sealing the upper crusts of road surfaces. In Perak the experiments were confined to Kinta, where 45,900 square yards of tar macadam and 55,000 square yards by the penetration method were laid. The cost seems to be from two to two and a half times the cost of similar water-bound surfacing, and there appears to be evidence that the life will be more than two and a half times that under the old method. It is too soon to form a definite opinion. In Selangor hardly any tar macadam has been tried, but tarco has been used very extensively. A sum of $86,000 was spent on 18½ miles of road tarcoed for the first time, and 30½ miles of road tarcoed for the second time. Where the traffic is not too heavy, and the road foundation is good, tarco seems successful, but until it is known how long the use of tarco delays the necessity of remetalling, it is impossible to compare costs. In the meantime, careful records of costs are being kept, not only where tar macadam or tarco is being used, but on adjacent portions of ordinary water-bound road, so that in time a definite comparison can be made.

A Vanilla Plant.—A vanilla-producing plant, *Vanilla ovalis*, has been found on the island of Mindoro (Philippines). The plant has roots similar to those of amlong, and found to be superior to amlong for use in basketry, as they are pure white and require no bleaching. The plant also has a leaf similar to that of one kind of amlong (*Pothos rumphii*), and in growth the two plants are very similar. The leaf of the vanilla plant, however, differs somewhat from the leaf of amlong in that it is unusually thick and is sessile. The plant is found both in open ravines and in deep forests, but is not plentiful. The Bureau of Education is investigating the plant with a view to ascertaining whether it may be developed commercially in making vanilla extract for trade purposes.

Seeth Manure.—Seeth, which consists of the residues of the indigo plant after the indican has been extracted, is well known as a valuable manure for tobacco. Its usefulness depends mainly on its power of aerating the soil and giving the tobacco roots an ample supply of air. Experiments are at present being conducted at the Agricultural Research Institute, Pusa, with the object of securing better returns from seeth. Evidence has been obtained that if the tobacco lands are mixed with small pieces of tile the amount of organic matter for the crop can be reduced. The cost is not very great, and a plot which was improved at Pusa in this way nine years ago still shows its superiority. If the present supply of seeth can be made to produce the same results on two or three times the area, the factories will be materially assisted and the indigo industry will receive an indirect benefit.

Argentine Tobacco Output.—According to *La Prensa* (Buenos Aires), the manufacture of cigarettes in Argentina last year reached a total of 550,000,000 boxes, while 300,000,000 cigars and 9,920,700 lbs. of leaf tobacco were produced.

THE LIBRARY.

The following books have been presented to the Library since the last announcement. Except where otherwise stated they have been presented by the publishers:—

Amphlett, George T.—History of the Standard Bank of South Africa, 1862-1913. Glasgow: Robert Maclehose & Co., Ltd.

Balls, W. Lawrence, M.A.—The Development and Properties of Raw Cotton. London: A. & C. Black, Ltd., 1915.

Beaumont, Roberts, M.Sc.—Woollen and Worsted. London: G. Bell & Sons, Ltd., 1915.

Berry, Henry F., I.S.O., Litt.D.—A History of the Royal Dublin Society. London: Longmans, Green & Co., 1915.

Birdwood, Sir George, K.C.I.E., C.S.I., LL.D., M.D.—Sva. Edited by F. H. Brown. London: Lee Warner, 1915. Presented by the Author.

Bone, Philip J.—The Guitar and Mandolin: Biographies of Players of these Instruments. London: Schott & Co., 1914. Presented by the Author.

Brenchley, Winifred E., D.Sc.—Inorganic Plant Poisons and Stimulants. Cambridge University Press, 1914. Presented by the Director, Rothamsted Experimental Station.

Calvert, Albert F., F.C.S.—Salt in Cheshire. London: E. & F. N. Spon, 1915.

Carpenter, Charles, D.Sc.—The Purification of Gas by Heat. London: South Metropolitan Gas Co., 1914. Presented by the Author.

Cleveland-Stevens, Edward, M.A.—English Railways. London: George Routledge & Sons, Ltd., 1915. Presented by the Director of the London School of Economics.

Cox, J. Charles, LL.D., F.S.A.—The English Parish Church. London: B. T. Batsford, Ltd., 1914.

Cressy, Edward.—Discoveries and Inventions of the Twentieth Century. London: George Routledge & Sons, 1914.

Crew, Albert.—Procedure at Meetings. Third Edition. London: Jordan & Sons, Ltd., 1915.

Darling, Charles R.—Liquid Drops and Globules. London: E. & F. N. Spon, Ltd., 1914.

De Villamil, Lieut.-Colonel R.—Motion of Liquids. London. E. & F. N. Spon, Ltd., 1914.

Eliot, Charles W.—The Road toward Peace. Boston. Houghton Mifflin Co., 1915. Presented by Dr. S. T. Armstrong.

Ficke, Arthur Davison.—Chats on Japanese Prints. London: T. Fisher Unwin, Ltd., 1915.

Franzen, Dr. Hartwig.—Exercises in Gas Analysis. Translated from the German by Thomas Callan, Ph.D. London: Blackie & Son, Ltd.

Gage, Professor Simon Henry, and Henry Phelps Gage, Ph.D.—Optic Projection. Ithaca, New York: Comstock Publishing Co., 1914.

Gardner, Walter M., M.Sc., F.I.C.—The British Coal-Tar Industry. London: Williams & Norgate, 1915.

Gaster, Leon, and J. S. Dow.—Modern Illuminants and Illuminating Engineering. London: Whittaker & Co., 1915.

Hardy, G. Hurlstone.—The Book of the Fly. London: William Heinemann, 1915. Presented by the Author.

Hobhouse, L. T., G. C. Wheeler, and M. Ginsburg.—The Material Culture and Social Institutions of the Simple Peoples. London: Chapman & Hall, Ltd., 1915. Presented by the Director of the London School of Economics.

Holloway, Thomas.—Levelling and its General Application. Third Edition. London: E. & F. N. Spon, Ltd., 1914.

Indian Year Book, 1915. London: Bennett, Coleman & Co., Ltd., 1915.

Kirkpatrick, Frederick A.—Imperial Defence and Trade. London. Royal Colonial Institute, 1914.

Knox, Gordon D.—The Spirit of the Soil. London: Constable & Co., Ltd., 1915.

Lawson, H. Heaton.—English and Commercial Correspondence. London: Blackie & Son, Ltd., 1914.

Leong, Y. K., LL.B., B.Sc., and L. K. Tao, B.Sc.—Village and Town Life in China. London: George Allen & Unwin, Ltd. Presented by the Director of the London School of Economics.

Martin, Edward A., F.G.S.—Dew-Ponds. London: T. Werner Laurie, Ltd.

Motor Cyclist's Handbook, by "Phœnix." Fourth Edition. London: Percival Marshall & Co., 1915.

Oakenfull, J. C.—Brazil, 1913. Frome: Butler & Tanner, 1914.

Peddie, J. Taylor.—(1) First Principles of Production. London: Longmans, Green & Co., 1915; (2) On the Relation of Imports to Exports. London: Longmans, Green & Co., 1915.

Pennell, Joseph, and E. Robins Pennell.—Lithography and Lithographers. London: T. Fisher Unwin, 1915.

Perris, George Herbert.—The Industrial History of Modern England. London: Kegan Paul, Trench, Trübner & Co., Ltd., 1914.

Phillips' Paper Trade Directory of the World, 1914-15. London: S. C. Phillips & Co., 1915.

Plimmer, R. H. A.—Practical Organic and Bio-Chemistry. London: Longmans, Green & Co., 1915.

Pulbrook, Ernest C.—The English Countryside. London: B. T. Batsford, Ltd., 1915.

Richardson, S. S., B.Sc.—Magnetism and Electricity. New Edition. London: Blackie & Son, Ltd., 1914.

Russell, Edward J., D.Sc.—(1) Soil Conditions and Plant Growth. New Edition. London: Longmans, Green & Co., 1915; (2) The Fertility of the Soil. Cambridge University Press, 1915. Presented by the Author.

Scott-Mitchell, Frederick.—Practical Gilding, Bronzing, etc. London: The Trade Papers Publishing Co., Ltd., 1915.

Scudder, Heyward, B.A., M.D.—The Electrica Conductivity and Ionization Constants of Organic Compounds. London: Constable & Co., Ltd., 1914.

Skrimshire, Samuel, F.S.I.—Valuations. London E. & F. N. Spon, Ltd., 1915.

Stratton, Mary.—Bruges: a Record and an Impression. Illustrated by Charles Wade. London B. T. Batsford, Ltd., 1914.

Talbot, H. H.—Blackie's Modern Business Arithmetic. London: Blackie & Son, Ltd., 1914.

Todd, John A., B.L.—The World's Cotton Crops. London: A. & C. Black, Ltd., 1915.

Travis, Charles.—Railway Rates and Traffic. Translated from the third edition of C. Colson's "Transports et Tarifs." London: G. Bell & Sons, Ltd., 1914.

Twelvetrees, W. Noble.—Rivington's Notes on Building Construction. Two Vols. New Edition. London: Longmans, Green & Co., 1915.

Verrells, H. Victor.—Experimental Hygiene. London: Blackie & Son, Ltd., 1912.

Vizetelly, Frank H., Litt.D., LL.D.—(1) The Development of the Dictionary of the English Language; (2) Essentials of English Speech and Literature. New York: Funk & Wagnalls Co., 1915. Presented by the Author.

Wilder, Gerrit P.—Fruits of the Hawaiian Islands. Honolulu: Hawaiian Gazette Co., Ltd., 1911. Presented by the Author.

Wireless Time Signals.—London: E. & F. N. Spon, Ltd., 1915.

Wolf, A., M.A., D.Litt.—The Philosophy of Nietzsche. London: Constable & Co., 1915. Presented by the Director of the London School of Economics.

Year Book of Wireless Telegraphy and Telephony, 1915. London: The Wireless Press, Ltd., 1915.

Journal of the Royal Society of Arts.

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FRIDAY, OCTOBER 29, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICE.

CANTOR LECTURES.

The Cantor Lectures on "Foodstuffs," by David Sommerville, B.A., M.Sc., M.D., Assistant Professor of Hygiene and Public Health, King's College, London, have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Royal Society of Arts, John Street, Adelphi, London, W.C.

A full list of the Cantor and Howard Lectures, which have been published separately and are still on sale, can also be obtained on application.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

HOUSE BUILDING: PAST AND PRESENT.*

By M. H. Baillie Scott.

Lecture I.—Delivered March 15th, 1915.

The subject for this series of lectures is a very wide one. I hardly realised how wide it was till I began to write about it, and I soon found that the main problem before me was not what I could say about it, but what I should be obliged to omit. After much consideration, I have deliberately chosen to deal mainly with what I may call, for want of a better word, the artistic aspect of building. In so doing I do not wish you to suppose for a moment that practical efficiency is not of fundamental importance. It is, in truth, the only sound foundation for worthy artistic ideals. But I think the modern tendency is to confine our attention too exclusively to the material aspects of the problems involved in building, and to consider the art of the matter as an entirely separate consideration, and not as the leaven which should humanise and spiritualise the whole of the enterprise. Because we rightly believe that sanitation is important, there is no reason why we should always be groping in the drains, forgetting the heavens above us. It is well that every material comfort and convenience should find its place in the modern house, but, since man cannot live by bread alone, the house should minister to something more than material needs, and should indicate some of those aspirations of the spirit which we find expressed in the old houses. The main object I have in view, then, is to indicate some of the obstacles to the realisation of this ideal, and to consider how they may be removed.

Before considering house building in the past or the present, it seems desirable to get some clear conception in our minds as to what building really means to us, and in what the art of it consists.

I believe I am right in assuming that the general modern impression about building is that in its simpler forms it is a rather dull sort of trade, and that only when it becomes elaborate and complicated does it become worthy of regard as an art. This elaborate building is popularly recognised as architecture It is built from the designs of architects, and may be readily distinguished from ordinary building because it has certain well-recognised architectural features. It has columns copied or adapted from Greek or Roman temples according to the fashion of the day, or in buildings set apart for religious purposes it may have Gothic pinnacles and cuspings. Now all these technical matters are little understood by the people, and even the highly educated are often timid in their judgments in matters connected with building. The architects are the high priests of the mysteries of architecture, and whatever they choose to do is accepted with equal

* All the houses illustrated are designed by the author.

FIG. 1.—"BURTON HOUSE," NEAR SHERBORNE. (The Entrance Front.)

indifference and apathy by the public. Of recent years, in public buildings, the architecture based on the ponderous gloom of Roman buildings has been all the mode, and this manner is carried on concurrently with various other fashions in smaller buildings. And, meanwhile, ordinary plain building is neither studied nor understood as an art. It has never apparently occurred to anyone that ordinary plain building is an art. The attitude towards building and architecture, which has led to this merely because it possesses unnecessary features and ornaments. A building is not to be transformed into a piece of architecture by mere trimmings, any more than a plain man is to be made into a gentleman by adopting a conventional garb. Let us clear our minds from all the recognised cant about buildings, and look at the realities of the situation; and, in order to get a more wholesome conception as to the qualities of building, let us compare the building art, which is so little understood and so seldom

Fig. 3.- "Burton House," near Sherborne. (The Hall.)

state of affairs in the building world, is supported by many high authorities. On referring to "The Seven Lamps of Architecture," by John Ruskin, I find it assumed, as a matter of course, that building itself is unworthy of regard as art, and it only becomes architecture when it includes useless features. He says architecture concerns itself only with those characters of an edifice which are above and beyond its common use.

Now I wish at the outset to dispute entirely this modern conception of building and architecture, and I refuse to reverence any building studied, with another art which is better understood and is more fully recognised—I mean the art of literature.

In choosing and arranging words on a page the purpose of the writer is essentially a practical one. It is his aim to convey a certain meaning by a certain arrangement of words, and we measure his power by the skill shown in such arrangement, which in its highest developments becomes what we call literature. Now it is quite impossible to say at what particular point mere writing becomes literature. It certainly does not

become so by the addition of unnecessary words or by elaboration of any kind. Indeed, on the contrary, I believe I am right in saying, and I believe that the best judges of literature will agree, that the test of good work is that its statements are direct and simple, and that no word can be removed from them without injury to the meaning. All this is well understood, and in such great works as the Bible, for instance, we find quite simple and artless tales which we all recognise as fine examples of this particular art. Now the principles which underlie all arts are the same, and so in the art of building, considered in its broadest aspect, we shall find man engaged, not in arranging words on a page, but in arranging brick and stone and wood on the earth. Here again the purpose of his work is fundamentally practical, and it becomes architecture, as writing becomes literature, not by elaboration or by ornament, or by any unnecessary trimmings, but by the skill and insight disclosed in the use of the means at his disposal. In building, as in writing, the real qualities of the work are elemental and not accessory. They cannot be extricated from fundamental construction. It is impossible to make any distinct dividing line between building and architecture. The best figure which I can put forward to illustrate my conception of building is to think of it as a plant we are growing which, if our gardening is good, may break into flower. The flower is the reward of the right kind of root culture. It may be quite unexpected and undreamt of. And this living bloom is quite a different thing from the imitation flowers deliberately copied from the classic gardens. It is evolved naturally and inevitably from the very life of the plant, and cannot be stuck on from outside. Here again it will doubtless be recognised that this figure of the plant represents the situation as regards writing and literature, for it is doubtful whether the best of the world's writers knew or cared whether they were producing literature. They merely used the best words to convey their meaning, and the beauty of their work was a thing they were unconscious of. But in the case of building we have no critics who understand it as literature is understood, and while the latest novel or musical comedy is the subject of expert criticism in the press, buildings are seldom considered as works of art at all. And as in modern times we have become a nation of newspaper readers, and as we consciously or unconsciously take so much of our opinions from newspapers, a great opportunity is lost of educating the public taste in matters connected with building by the lack of recognition of the building art in the popular press. A new church is vaguely referred to as in the Early English style of architecture, and the writer is obviously unaware that Early English architecture was the expression of the soul of Early England, and that the reproduction of the same forms in modern cast-iron workmanship, according to contract, is but an empty husk compared with the genuine article it imitates. For there is all the difference in the world between an inspired creation and the imitation of an inspired creation.

In trying to show that the merit of a building does not necessarily lie in the architectural features, I do not wish to suggest that all elaborate building is to be condemned, but merely that beauty in building does not necessarily consist in elaboration, and that generally a certain simplicity will be the mark of the best work. Elaboration and ornament seem to me only justifiable as the spontaneous expression of the joy of the worker—a breaking forth into song. As such it stands in the building as a kind of petrified joy, and persists as a symbol of something great indeed. But, since the corruption of the best is always the worst, when elaboration and ornament is used in a perfunctory and lifeless way, it becomes a useless stupidity In building, as I understand it, while we are bound to do honest and sound work, we are in no way bound to use elaborate ornament or architectural features, and there is no mysterious alchemy which transmutes plain building into architecture by such additions.

It does not come within the scope of my subject to deal with public buildings, and I only allude to them in passing, because they illustrate some curious developments in building methods which so far have not yet shown themselves in house building. The fashion of the day for public buildings may be expressed in the following formula. Work out your structure in a skeleton of steel and concrete, and when this is done conceal these essential factors of the constructional scheme with a screen composed of architectural features copied out of books. The curious compound resulting from this fundamentally unsound and dishonest process is usually described as classic architecture. But those of us who have our own conception of classic architecture may perhaps be pardoned for not accepting it as such. Picture to yourselves for a moment the Greek temple: think of the broad spaces of sunlit marble, the brilliant

colour of its sculptures, and the exquisite subtleties of its outline, and then turn from this bright and beautiful vision to the dismal gloom of the buildings we now claim to be classic in their inspiration. One is reminded of a certain scene in the "Diary of a Nobody," when an imitation of Irving was proposed by a visitor to a suburban household. Whereupon the hostess, a lady more remarkable for domestic virtue than personal charms, entering gleefully into the business in hand, said, "And I'll be Ellen Terry." Just as gleefully and irresponsibly does the modern architect set forth to be Greek. It is easier to be Roman perhaps, for that is the heavy-father part. The departed spirit of Bumbledom must be invoked, or perhaps Malvolio. You must be gloomy and impressive. It is called the "Grand Manner." Above all, you must not laugh. One imagines that just one explosion of mirth would shatter and destroy all these solemn nightmares. Classic architecture in the modern world—and the Grand Manner of building generally—stand for pride. There is no humility in it, and the antic man postures and plumes himself at large. And the cure for all this is the proper cultivation of a sense of humour. It is much to the credit of modern life that these bombastic buildings do not interest anyone, and the only reason for their production is due to the fact that all public buildings are produced under a competitive system, in which the professors of the Grand Manner are at present the sole arbiters.

FIG. 4. "BURTON HOUSE," NEAR SHERBORNE. (The Hall Fireplace.)

In the building of houses there is some small hope of better things, because those who still understand something of the possibilities of building as an art may find in the house a means of expressing their ideals, untrammelled by official standards. But the trend of modern thought is so largely infected by utilitarian and mechanical ideas that the general atmosphere is too often fatal to the growth of any real building art. The house is considered as merely a combination of conveniences, hot-water taps, labour-saving appliances, and so on. I have no

wish to undervalue these things. They are undoubtedly of great importance. But I can never accept a hot-water tap in exchange for all those noble qualities which have been and may yet be expressed in building, and I would rather think of the house as a temple to the household gods than as a mechanical contrivance which would reduce all human activities to the single act of pressing a button. I think it was Professor Lethaby who said, "A house should be as efficient as a bicycle." That is quite true as far as it goes. But it is apt to mislead us if we suppose that the problems involved in building a house or in making a bicycle are of the same kind. The function of the bicycle is such that in making it all our doings are strictly governed by insistent conditions which admit little latitude for creative choice, and its ultimate form is the resultant of remorseless material forces. But in the building of a house no such conditions restrict us. We have to enclose and to roof over a piece of space, and subdivide this space for the purposes of habitation, and according to the usual modern formula we may allot spaces for drawing-room, dining-room, and so on. Now I do not think you can tell me of any natural law which insists on any definite size or shape for any of these apartments; and, supposing the house to be wind and weather proof, to be conveniently arranged and completely warmed and lighted, there is still a large margin for creative choice in its forms and details—in the proportion of its rooms, in the technique of its workmanship, and in the qualities of its materials. It is, then, impossible to escape from the conclusion that the

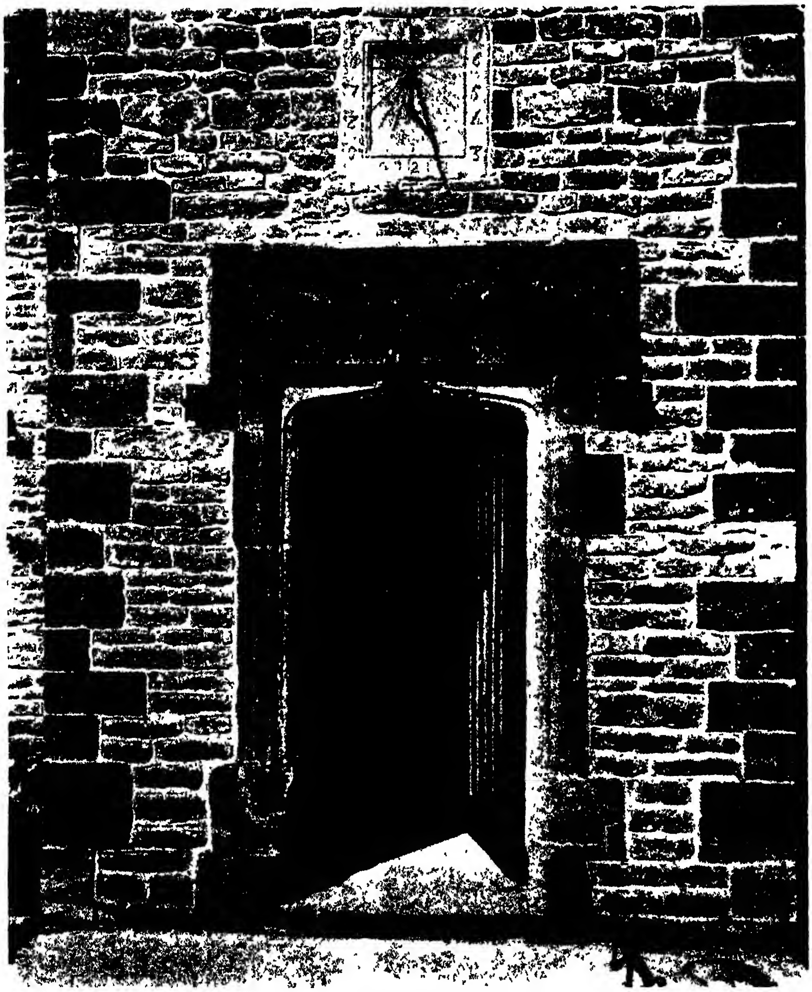

FIG. 5.—"BURTON HOUSE," NEAR SHERBORNE. (Garden Porch.)

creation of a house is essentially an artistic matter involving deliberate selections and rejections, not entirely subject to utilitarian restrictions; art, either good or bad, cannot be excluded from its conception and execution. And the most valuable kind of art in house-building is that which is intimately associated with the proportion of its masses and the very bones of its anatomy, so that, when stripped of all its superficial adornments, its wallpapers and its curtains, it still preserves unimpaired, if unadorned, its essential qualities.

the modern bicycle is better than the old bone-shakers or velocipedes, as they used to be called in the days when cycling was a fearful and hazardous adventure. But there is this difference between the proper subjects for scientific study and those which are governed by artistic principles. In the former we may expect advance and improvement coincident with the material progress of civilisation, but in the latter it is often found the earlier work is better than the later, and so the old picture may often be better than the latest expression in painting,

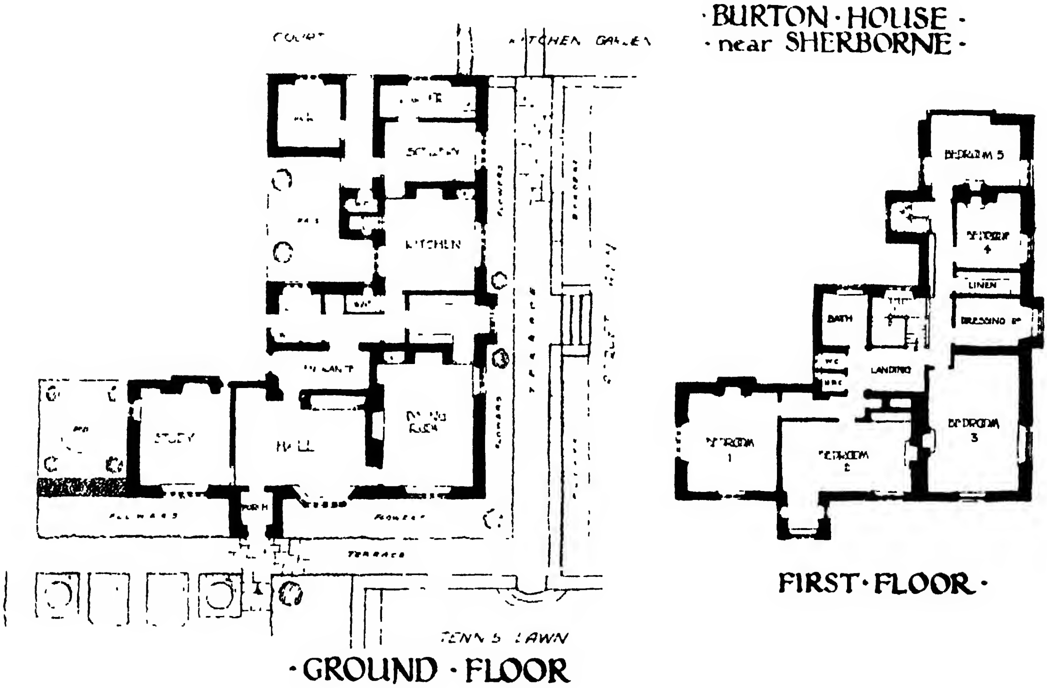

Fig. 6.

The idea that house building is merely a matter of practical utility and not, like the painting of pictures for instance, essentially an art, leads us naturally to suppose that the modern house is necessarily, as the outcome of a long experience, especially adapted to our needs, and in every way an advance on the older houses. If we wish to obtain the greatest efficiency in a locomotive, we should not in these days be inclined to use the earlier types of engines, and we rightly prefer a Rolls-Royce motor-car to Stephenson's "Rocket," for the whole development of such means of locomotion has been a continual advance in efficiency. So

and the old house better than the modern villa. Give me an old house—let it be as early in date as the twelfth century if you like—and after adding a bath and cooking range, and a few hot-water pipes, which constitute almost the only contribution to the efficiency to the house that modern times have supplied, the old house shall make as good a dwelling for all practical purposes as any modern house, and in addition, as a work of art, it has a value difficult to measure or describe in words and qualities, which with all our enlightenment and knowledge we have forgotten how to produce.

In thinking of building, then, I want to try

to dispel the idea that architecture is an elaborate and complicated kind of building which we in our modern enlightenment have evolved out of the darkness and ignorance of the past. I want to substitute for this conception of the building art the idea that whatever real greatness a building may possess is rooted in the essential facts of its structure. It lies in little homely everyday things and in work affectionately done.

This old way of building we have lost, and, until we can regain it, it is idle to indulge in extravagant dreams about architecture, for all true architecture grows out of good building. It cannot exist without a universal habit of good building. And do not let us imagine that art is in any way degraded or obstructed by the fact that it has to deal with practical problems such as are involved in ordinary building. Pure art, as it has been called, which lives in a dream world apart from the actualities of our daily life, soon becomes emasculated and trivial. Lacking the tonic influences which contact with life brings, it loses its virility and ends by becoming a frivolous and dilettante affair, practised by a limited cult of superior persons. If we consider the works of Nature, we shall find no pure art there. The most beautiful creations all have their practical functions to perform. There is no part of the trees or flowers which is not designed for a purpose to which it is delicately adjusted, and in the human frame the beauty of eye would be nothing without sight, the arm nothing without might. Beauty in all these cases cannot be extricated from its connection with practical functions. If art is to have any real significance it must cling closely to life, and be the informing spirit in all man's doings in the world, and its central task must be concerned with the creation of houses with all the appointments of daily life.

The idea that there is something vulgar in usefulness, and that art is only to be concerned with useless tasks, is a doctrine which flourished in Victorian days. It is a doctrine which is dying hard to-day. It is a doctrine which is refuted by every old English town and village and by all the treasures of our museums, while the fruits of it are seen in the manifold ugliness of modern life. Let us hope that art may be again what it has been in the past, the reward of all constructive labour, and not only the possession of a few, so that the craftsman may recapture some of that dignity and joy of life which was once his portion and his heritage.

TOBACCO, GINSENG, AND COTTON CULTIVATION IN KOREA.

Tobacco.

The annual importation of yellow tobacco leaves from America by Korean manufacturers as material for the manufacture of cigarettes, amounts to about 828,000 lb. In view of this the Government-General has for several years been carrying on experimental plantations of American tobacco in Korea. It has shown that the climate and soil of that country are well suited for the cultivation of this species. In 1912 the Government-General established a station in Choongju, North Choongchongdo, for experimental work, and at the same time for the encouragement of tobacco cultivation among the local farmers. According to a report by the United States Consul-General at Seoul, the result was satisfactory, the area of land devoted to this variety of tobacco being steadily on the increase. In the first year (1912) the ground planted with it was only thirty-seven acres, but last year it increased to 294 acres, with a crop weighing 331,200 lb. As the cultivation is carried on only under the direction of the experiment station, cultivators are required to secure permission of the authorities before planting (in January or February). Since tobacco leaves produced on one acre of ground range in value from £8 to £16, the yield is quite lucrative to the farmers. Under the circumstances many farmers are now desirous of undertaking its cultivation; but, fearing over-production, the authorities believe it advisable to restrict the area. It is reported that 1,225 acres is the area for which permission has been requested for 1915, but that the aggregate area destined to receive official permission is only 490 acres.

Ginseng.

Ginseng farms harvested in 1914 aggregated 161,906 kan (about 647,624 square yards), producing 280,166 lb., of which the Government purchased 75,969 lb. of the best grades at a cost of £35,000, or 9*s*. 3*d*. per lb., for the manufacture of red ginseng. In comparison with the average annual production of the six years ended 1913, there is shown an increase of 33,675 lb. as the result of the strict measures taken by the Government for the prevention of disease, which has heretofore hampered this industry. The roots harvested in 1914 were planted in 1909.

Cotton.

The total area of land devoted to the cultivation of cotton of the Upland species during 1914 was about 51,450 acres, the crop obtained being estimated at 28,000,000 lb. in weight. As a result of the encouragement given to farmers to plant this grade of cotton, the area devoted to the industry is increasing year by year, and it is estimated that during 1915 land planted with Upland cotton will reach 83,300 acres, an increase of 31,850 acres over the preceding year.

MILITARY TRAINING IN SCHOOLS.

As a sign of the times it is interesting to note that no fewer than three papers on the subject of military training in schools were read before the Education Section of the British Association at Manchester.

Mr. A. B. Wood presented a review of the systems of training in the British Empire, and in various foreign countries, with the object of supplying some undisputed facts as a basis for the scientific discussion of the problems. In the brief printed abstract of his paper one or two cases only are given.

Australia.—In Australia all male inhabitants (except those specially exempted) are liable to military service in time of peace as well as in time of war. This principle of compulsory military training was made law in 1909, and came into operation in January 1911. The Defence Act provided compulsory military education for boys as follows:—

Rank.	Age.	Service.	Training.
Junior Cadets	12-14 years	2 years	Annually—90 hours.
Senior Cadets	14-18 years	4 years	Annually—4 whole days, 12 half-days, and 24 night drills.
Citizen Forces (Militia)	18-26 years	8 years	Annually—In first 7 years drills equivalent to 16 whole days (including 8 "camps").

When in full operation this system involves the training of 100,000 Senior Cadets and 128,000 Militia (the population of Australia—excluding aboriginal natives—being about 4½ millions). The Junior Cadets (12-14) are given a general physical training, including swimming, first-aid, and miniature rifle-shooting. Senior Cadets (14-18) are subject to military discipline, and have regular military drills and rifle practice. On attaining the age of 18 the boys, if fit, are transferred to the Militia.

The expense of this training, as part of the educational system, is wholly included in the ordinary Education Budget.

Certain provision is made for "religious objectors" and "anti-militarists."

Reports by the Premiers of the various States of the Commonwealth give ample testimony to the success of the system.

New Zealand.—By the Defence Act of 1910-11, compulsory military training is provided for every male person between the ages of 14 and 35 years. Between the ages of 12 and 14 the boy receives a certain amount of physical training in the elementary school. At 14 he joins the Senior Cadet Corps, his subsequent training being now conducted on lines similar to the Australian system.

South Africa.—The Defence Act of 1912 provides that all boys between the ages of 13 and 17 years shall undergo a prescribed course of military training annually. The Act provides for compulsory military training "only where it can be carried out efficiently," *i.e.*, in urban and populous areas. In scattered districts Defence Rifle Associations are formed.

Sweden.—Compulsory military training was introduced into Swedish schools fifty years ago. Military exercises are given in all secondary schools, special emphasis being placed on rifle practice, at which 60 hours annually must be spent by every boy between the ages of 15 and 18 years inclusive. In elementary schools physical exercises are given regularly, but no rifle practice.

Norway.—The system here is similar to that of Sweden.

The value of this military training is estimated by referring to the reports of the respective Governments. All these reports describe the compulsory system of training as a great success, both from the point of view of the boy as an individual and the nation as a whole.

In the British "system," which is entirely voluntary, much excellent work is done by various voluntary organisations, such as Church Lads' Brigades, Miniature Rifle Clubs, School Cadet Corps, Boy Scouts, etc., and it becomes necessary to decide whether or not such a voluntary system could be improved by adopting a more centralised and systematic Government organisation of Cadet Corps on lines, say similar to that of the Australian system.

The second paper, by the Rev. A. A. David, discussed the subject from several points of view:—

1. *Its Bearing on National Needs.*—The question is not altogether separable from the wider question of Universal or National Training. It is fair to point out that the recent sudden demand for a very large number of officers in all branches of the British Army would not have been met as it has been but for the careful and continually improving military practice in public schools for the last thirty years, but especially since 1908.

2. *Suggestions for a Continuous Course.*—At elementary or preparatory school stages—drill and scouting. In public schools—ditto, with field practice and elementary tactics and much exercise in handling squads, sections, etc., leading

to Certificate A, and at a later stage to further training for officers and Certificate B.

3. *Effects on the Individual Boy.*—(a) *In body.* Good drill demands and induces alertness of ear, ready attention, and muscles under instant control. Physical exercises for straightening, smartening, and strengthening, are probably best done as part of military training. And all this is most easily taught and learnt quite early in school life. (b) *In capacity and character.* To prepare a man to be a soldier means to produce in him faculties and powers which are of more than merely military value, *e.g.*, in connection with the giving, receiving and transmitting of orders, the appreciation and enjoyment of smartness and orderliness, and later on responsibility, initiative, and leadership. (c) *In intelligence.* Experience has proved the educational value for older cadets of tactical problems for Certificate A, map-making and reading, and other field work.

4. *Effect on the School.*- Here again experience has shown that a good training corps reacts on the life of the whole school. For instance, in boarding schools it is now exerting and, it is hoped, will continue to provide a wholesome check upon the undue exaltation of games; whereas in day schools, where compulsory games are often impossible, it supplies a wholesome and practical form of exercise and change of interest. And it has also been found that a really efficient corps raises the standard of discipline, and even of efficiency in other departments of school life. But the drill must be good. Bad drill is worse than no drill. Much of the opposition to school training dates from a time when little was expected of Volunteers, before they were taken seriously by the authorities.

5. *Objections.* – The objectors fall into two classes: (*a*) Those whose hatred of all war leads them to condemn all military training whatsoever. Such views cannot fail to win respect for those who hold them. In a world of hard realities and second-bests we cannot afford to be without men who will thus continually remind us of what ought to be possible, but neither can we afford to act on their advice. (*b*) Those who fear an "English militarism." But why should we suppose that English boys would catch a spirit and follow an example which the whole world is recognising to be ridiculous, odious, and disastrous?

Mr. A. A. Somerville traced the growth of the idea through its various stages, ridicule, recognition, and, finally, gratitude, and dealt with the objections to the movements, and with its effects on individual character, as a centre of discipline and usefulness in the school, its value as a means of training officers, and generally as an example to the country. The present generation, he urged, is undisciplined; the next will have a far higher sense of discipline and duty.

MOTOR FISHING-BOATS IN SCOTLAND.

It is interesting to learn from the annual report of the Scottish Fishery Board that, in spite of the war conditions which have seriously interfered with the fishing industry, not only by severely restricting the areas in which fishing can be carried on, but also by withdrawing large numbers of men and boats for mine-sweeping and other operations, the returns regarding motor fishing-boats again show a substantial increase in the number of registrations, the total for 1914 being 694, as compared with 523 in 1913, an increase of 171. This rise is the greatest that has yet been recorded for any one year. The increase in the largest class (over 45 ft. keel) is one of the striking features of the year.

As in 1913, most of the boats in which motor-power was installed were sailing-boats already on the register, and only a few boats were specially built for motors.

The types of engine which have in past years been found most suitable by the fishermen continued in favour during 1914, although one or two new makes were introduced. In the Clyde and some other districts the tendency towards higher powered motors, which was mentioned in the report for 1913, was again apparent.

The reports received from the Board's officers continue to show that, as a general rule, the cost of installing motor-power is a sound investment. In most cases in which the earnings of motor-boats do not considerably exceed those of sailing-boats of the same size, it appears that the failure was largely due to lack of enterprise on the part of fishermen, and the continued substantial increase in the motor fleet is, of itself, conclusive evidence of the value of motor propulsion in fishing-boats.

PRODUCTION OF YERBA MATÉ (PARAGUAYAN TEA).

The Paraguayan Government has recently compiled figures showing the estimated production of yerba maté (Paraguayan tea) for 1915, compared with the actual production in 1914, from which it appears that there is expected to be a decrease this year. The figures are as follows:—

District.	1914 lb.	1915 lb.
Concepcion	2,843,934	1,979,731
San Pedro	7,987,817	7,028,265
Guaira	--	16,534
Yhu	601,856	1,313,942
Caazapa	22,046	440,920
Encarnacion	5,877,464	4,761,936
	17,333,117	15,541,328

According to a report by the United States Consul at Asuncion, yerba maté is the daily household beverage of the masses of Paraguay, and is consumed also to a large extent in Brazil and Argentina. It has been introduced into Europe, where its use is increasing.

CORRESPONDENCE.

THE VALUE OF BIRDS TO MAN.

The many calls on my time since I returned to London last month have precluded until now the possibility of my replying to Mr. Frank Cundall's letter in the *Journal* of August 20th, 1915.

It is not at all certain that the importation of infected cattle was the agency by which the tick pest was first introduced into Jamaica. There are ten species of ticks in the island, all of which have a wide distribution. The fact that the Texas-fever tick (*Rhipicephalus annulatus*) is found in North and South America, several of the West Indian Islands, Africa, Europe, Asia, and Oceana, and that it was mentioned by Aristotle, makes it extremely unlikely that it found its way to Jamaica only in recent years. My belief is that it has been long present in the island, and that the agency which first carried it there was the wind. With such atmospheric disturbances as occur in these regions it would be strange if the "grass louse" -the tick in its larval stage—had not been carried to the island. My belief that the tick has been long present in Jamaica is strengthened by the fact that native breeds of cattle enjoy an almost total immunity from the plague, while imported breeds suffer terribly. This immunity, I believe, is to be attributed to former attacks, stretching backwards, through generations, just as zebu cattle are not susceptible to rinderpest, or some black peoples to syphilis. In a word, they are inoculated.

I am aware that it is only in comparatively recent years that the pest has become alarmingly manifest. I am also aware that it is only in Jamaica that ticks have become such a pest, and, furthermore, that their inordinate increase is synchronous with the inordinate decrease of insect-eating birds. Up to a little over forty years ago, the period when the millinery interest began its devastating work, bird-life was extraordinarily abundant in Jamaica. In consequence, grass ticks are not mentioned in the records of that time. The balance of Nature's forces had not been disturbed, and the birds were able to exert a constant check on the undue multiplication of the insect. At first, the plume hunter sought only the plumes of the egret and the skins of the humming-bird. Rapidly his evil work widened its scope, until it included all types of birds which carried marketable feathers. The number of bird skins from Jamaica which poured into Europe and into New York City, when the slaughter was at its height, is truly appalling. It is not easy for me to recall to memory the hundreds of thousands I have seen in England, France, Holland, and Germany, without the feeling of indignation I experienced at the time again rising within me. Whole species have been wiped out of existence, while of those that were most abundant only a pitiful remnant remain. We all know that the mongoose is a great culprit, but to attempt to saddle him with the responsibility of this crime is too absurd for serious consideration.

I know that there is a Birds and Fishes Protection Law in Jamaica, which provides for the protection throughout the year of a large number of insect-eating birds. I know, also, that this law is a sham. The only purpose it has served is to fill the mouth of the gunner with laughter.

To understand how easy it was for the bird, under natural conditions, to keep the tick in check, we must consider the life-cycle and habits of the latter. All the Jamaican ticks undergo a metamorphosis, which consists of four stages. The eggs are laid on the ground, agglomerated in a heap. On hatching from the egg, the larvae, or "grass lice," crawl up the stems of grasses, congregating at the top in enormous numbers. As many as 2,250 larvae have been counted at the top of a single blade of grass. The elevated position is chosen because the single end the larvae have in view is to attach themselves to a passing host as it sweeps through the herbage; and they attach themselves to almost all terrestrial vertebrates, including man. When the larva has secured a host, it satiates itself with blood, falls to the ground, moults, and reaches the third stage—the nymphal. The nymph again climbs to the top of a grass stem or other elevated and exposed position, and again awaits a host. The host secured, it gorges itself with blood, falls to the ground, casts its skin, and undergoes the final change, which gives it sexual organs. The fourth stage has been reached. The adults, both male and female, ascend to the top of a tall blade of grass, or other plant, and for the third time await a passing host. The host having been found, they pair, and then both take a meal of blood. The female becomes enormously distended, falls to the ground, lays her eggs, and dies. This sketch is necessarily slight and incomplete, but it will serve to show that throughout the whole life-cycle the tick, in whatever stage it may be, is an invitation for the bird to come and feed. In Jamaica, seventy-four adult ticks, all females in an engorged condition, have been taken from the stomach of a bird after its early morning meal. Mr. Wortley computes the average number of eggs laid by a female tick to be, approximately, 7,000. The number of ticks, therefore, destroyed in the embryonic stage by this bird at one meal was over half a million. We have but to remember that digestion is exceedingly rapid in birds, and that for the most part birds feed most of the time, to realise that the number of ticks eaten by birds, when there were birds to eat them, must have been beyond human comprehension or computation.

The two following extracts from official reports will give some idea of the dimensions the tick pest in Jamaica has assumed since the insects have been left without check.

The first extract is from the Reports of the Twenty-first Expedition of the Liverpool School of Tropical Medicine, Jamaica, 1908-9: "One of the greatest problems which confronts the pen-keepers of Jamaica is the eradication or control of those

ticks, which, by their vast numbers, have rendered nearly all the grazing districts of the island insufferable to man, and a veritable plague to his domesticated animals. For forty years these pests seem to have been rapidly increasing, and to-day they swarm in incredible numbers, and are a menace to the stock-raising industry of the country."

The second extract is from the Report of the Department of Agriculture for 1913–14, issued by the Colonial Government, and published at the Government Printing Office, Kingston, Jamaica, 1915. "Experience teaches us that there is no such thing as immunity for an imported dairy cow in Jamaica, and we must expect all our imported cows to succumb to tick-fever sooner or later."

Mr. Cundall states that the island of Jamaica is remarkably suitable for the breeding of cattle. This, under existing conditions, it never can be Native stock do not fatten until they are four or five years old, while Jamaica-bred cows give but a very poor yield of milk. There must be an improvement in the breeds before Jamaica can hope to hold her own against foreign production and importation of dairy produce. What is required is earlier maturity and better fattening qualities amongst the butcher's stock, and much larger milk production for dairy purposes. This cannot be arrived at. Any attempt to improve the native breeds by importing superior stock must end in failure, since the imported stock die out.

By washing, dipping, and burning pastures, the pen-holders are attempting, at enormous cost, to do a work that the birds, previous to their destruction, had performed free of charge. Yet wash, and dip, and burn, as they may, the pen-holders are obliged to admit that they are impotent against the enemy. The only remedy is to recall the bird. Unfortunately, local opinion on the subject is absolutely dead. But if the people of Jamaica do not awake from their slumber, if they do not crush the bird-destroyer, their chance of ever freeing themselves from the tick pest is a remote one.

JAMES BUCKLAND.

OBITUARY.

CAPTAIN SIR ANDREW NOBLE, BT., K.C.B., D.Sc., Sc.D., D.C.L., F.R.S.—Sir Andrew Noble died on the 22nd inst. at his residence, Ardkinglas, Argyllshire.

He was born at Gourock in 1831, and after being educated at Edinburgh Academy and the Royal Military Academy, Woolwich, he entered the Royal Artillery in 1849, and attained the rank of captain in 1855. In 1858 he was appointed secretary to the Committee on Rifled Cannon, and in the following year to the Committee on Plates and Guns. In 1859 he also became Assistant-Inspector of Artillery, and was employed in the proof department of the Arsenal at Woolwich. In 1860 he was made an associate member of the Ordnance Select Committee, and a member of the Committee on Explosives, on which body he continued to sit until its dissolution in 1880. In 1860 also, on the invitation of Sir William Armstrong, he entered the firm of Sir W. G. Armstrong, Whitworth & Co., Ltd., of Elswick, at first as a salaried official, but shortly afterwards as a partner, and no doubt the great engineering and scientific reputation of the firm was due in large measure to his remarkable powers of organisation

Sir Andrew Noble's researches into the phenomena attending the firing of a gun were started very soon after he became associated with Sir William Armstrong. In 1862 he conducted the first electroballistic investigations made in this country, and invented the Noble chronoscope for determining the velocity of a projectile in the barrel of a gun. Later on, in conjunction with Sir Frederick Abel, he carried out the long series of experiments on "Fired Gunpowder" which have now become classic in the history of explosives.

He next turned his attention to smokeless powders, and to cordite in particular, and after long and laborious investigations he succeeded in obtaining muzzle-velocities of over 3,000 ft. a second, or double those obtainable thirty years before, together with an energy and capacity for penetration about four times greater than had then been practicable. In a lecture delivered before the Royal Institution in 1907 he stated that in the past fifty years he had investigated "no fewer than eighteen distinct propellants, determining for most of them on an elaborate scale the transformations which occurred when they were fired at very different pressures."

In recognition of his services to science Sir Andrew Noble was elected a Fellow of the Royal Society in 1870, and ten years later he was awarded their Royal medal; he received the honorary degree of D.Sc. from the University of Oxford, and of Sc.D. from the University of Cambridge; he was created a C.B. in 1881, a K C.B. in 1893, and a baronet in 1902. He was also member of a large number of foreign orders, including the Crown of Italy, the Sacred Treasure and Rising Sun of Japan, the Rose of Brazil, and the Order of Charles III. of Spain. He became a member of the Royal Society of Arts in 1882, and in 1909 he received the Society's Albert Medal "in recognition of his long-continued and valuable researches into the nature and action of explosives, which have resulted in the great development and improvement of modern ordnance."

PROFESSOR VIVIAN BYAM LEWES.—Fellows of the Society will learn with much regret of the death of Professor Vivian B. Lewes, which took place on the 23rd inst. at Mold, Flintshire, from an attack of double pneumonia.

He was born in 1852, and was educated at University College, London. In 1879 he became Assistant to the Professor of Chemistry at the Royal Naval College, Greenwich; and on the retirement of Professor Henry Debus in 1888 he was appointed his successor, a post which he occupied till 1914. He was thus well known to nearly every officer in the British Navy, to whom his lectures on high explosives, etc., were always of the deepest interest. He was also Chief Superintending Gas Examiner to the City of London from 1892 to the time of his death. But it was as a popular lecturer that he was best known to the public, and nowhere was he a greater favourite than at the Royal Society of Arts. It is over twenty-five years since he first appeared in the Great Room, when he delivered a course of Juvenile Lectures on "The Story of a Flame." Later on in the same year (1890) he gave four Popular Lectures on the "Atmosphere," and in the autumn a course of Cantor Lectures on "Gaseous Illuminants." In 1892 he read a paper on "The Spontaneous Combustion of Coal and its Prevention," for which he was awarded the Society's silver medal. This paper was followed by the following lectures and papers: Cantor Lectures on "The Generation of Light from Coal Gas" (1892); a paper on "London Coal Gas and its Enrichments" (1894), for which he received a second medal; Cantor Lectures on "Explosives and their Modern Development" (1894); a paper on "The Commercial Synthesis of Illuminating Hydrocarbons" (1895), for which he received a third medal; Cantor Lectures on "The Use of Gas for Domestic Lighting" (1896); a paper on "Water Gas and its Applications" (1898); Cantor Lectures on "Acetylene" (1898); Cantor Lectures on "The Incandescent Gas Mantle and its Uses" (1900); Cantor Lectures on "The Future of Coal Gas and Allied Illuminants" (1902), Cantor Lectures on "Fire, Fire Risks, and Fire Prevention" (1906); Cantor Lectures on "Fuel and its Future" (1908); Cantor Lectures on "The Carbonisation of Coal" (1911); a paper on "The Testing of Safety Explosives" (1913); Cantor Lectures on "Liquid Fuel" (1913); Fothergill Lectures on "Motor Fuels" (1915); and a course of Special War Lectures on "Modern Munitions of War" (1915).

From this list it will be seen that Professor Lewes was a very extensive contributor to the proceedings of the Society. He made no fewer than sixty appearances on the platform of the Great Room, and in this respect he very easily holds the record. His lectures were invariably well attended, frequently crowded. He was undoubtedly a very attractive lecturer: he spoke with a fluency that astonished strangers, and he never had occasion to use a single note. He was, of course, a speaker of very great practice, for in addition to the work which he did in connection with the Royal Naval College and the Royal Society of Arts, he lectured a great deal for the Gilchrist Educational Trust, and for other bodies.

GENERAL NOTES.

Indian Pamphlets on the War.—With a view to fighting against the campaign of lies, wilfully circulated by German statesmen and professors as to the genesis of the war, Mr. Cassamally Jairazbhoy, Vice-President of the Bombay Branch of the Moslem League, has resolved to print and publish occasional pamphlets in English and the vernaculars at his own cost, and to circulate them broadcast among the Indian people. Two of these, entitled "India and the War" and "The Suicide of Turkey," have been received. The first is an examination of German policy and of India's duty in supporting the cause of civilisation. "When the history of the war comes to be written," says the author, "there will be no more interesting and glorious chapter than the bright page dealing with the despatch of Indian troops for the defence of the Empire, the heroic part played by them in upholding the glory of the Empire, and the loyalty shown by her princes and peoples, who are all animated with the desire to wipe out the common foe. This war is meant to decide if modern civilisation shall be ruled by brute force or by the enlightened will of free peoples. India has furnished the only possible reply, which has found eloquent expression in the great wave of loyalty that has swept from the Himalayas to Cape Comorin, and from Mandalay to Karachi." The pamphlets are written with admirable vigour and reasoned constraint, and the fact that they have already run into several editions should assure the author that they are carrying out the patriotic and loyal purpose for which they were intended.

American Cars and Tyres for England and France.—Commenting on the remarkable increase in the exportation of motor-cars from the United States, owing to the European war, the *Autocar* remarks that the actual figures are surprising. Exceeding by far the purchases of all other countries combined, the United Kingdom stands at the head of the list with a total of 4,036 cars, valued at £1,179,171, during the month of May last, as compared with 663 cars, valued at £111,350, during the corresponding month of last year, while for the eleven months ending May, 1915, the figures were 11,688 cars, valued at £3,347,233, as compared with 6,982 cars, valued at £1,122,770, for the corresponding period ending May, 1914, and 3,593 cars, valued at £547,487, for 1913. France took 521 cars during May, 1915, as compared with 275 in May, 1914; the number of American cars exported to France during the eleven month ended with May for the last three years being 4,472 for 1915, 1,286 for 1914, and 753 for 1913. The exportation of American motor-car tyres to England also shows a remarkable increase, their value for the eleven months ended May last being £457,898, as compared with £262,186 for the corresponding eleven months ended May, 1914, and £196,322 for 1913.

Technical Education in West Africa.—The *Colonial Journal* publishes some particulars of the scheme dealing with a sum of £20,000, with accumulations, bequeathed by Sir Alfred Jones for the promotion of technical education in West Africa. £10,750, with an equivalent sum to be contributed by the Government of Nigeria, will be devoted to the building and maintenance of a technical institute or workshops in that Protectorate, for the purpose of elementary education and practical workshop and mechanical training. £5,375 are to go to the building and maintenance of trade schools in Sierra Leone for instruction in blacksmith's, carpenter's, or other manual work. The remainder of the legacy is to be applied to technical education or mission schools in the Gold Coast, under a scheme to be hereafter settled.

The Oxyacetylene Process and Life-saving.—The *Acetylene Lighting and Welding Journal* records the fact that a new use has been made of the oxyacetylene process in preserving life. It will be remembered that the large Chicago passenger steamer "Eastland" suddenly capsized at her moorings on July 24th, with 2,480 souls on board. A large number of these were imprisoned in the inverted hull. Shortly after the accident two members of the city detective bureau recalled having seen an oxyacetylene operator at work on a building at a short distance from the scene of the disaster. They brought him, with his equipment, back to the boat at top speed. In three minutes he had cut a hole 2 ft. by 2 ft. in the half-inch plate next a porthole, and a moment later three half-drowned victims were drawn through the hole. Oxygen apparatus was used for resuscitation purposes. As every second counted, additional operators were procured, and many victims were rescued. The cutting operators worked steadily from the time of the disaster, 7.40 a.m., on the 24th, to 6 p.m. on the following day.

Trade Conditions in Russia.—A feature characteristic of the Russian market, according to His Majesty's Consul at Batoum, is the smallness of the capital employed in trade. Both commerce and industry, particularly in their more modern branches—*e.g.*, sundry machinery, lathes, motors, etc., are mostly in the hands of people without capital, who are, therefore, able to do business only on credit. Credit is an absolute necessity to the great bulk of persons engaged in trade and industry in Russia. German firms knew this well and developed trade extensively, thanks to the credit given. German manufacturing firms have been known to accept orders for up to £12,000 to £15,000 worth of machinery, and to receive only from £2,000 to £4,000 on account, a sum which in most cases would barely suffice to pay duty on the goods and the expense of erecting the plant. The payment of the balance due on the machinery was spread over a period of from two to three years. The sale of motors on a system of one to two years' credit has become a common rule.

MEETINGS FOR THE ENSUING WEEK.

Monday, November 1...Farmers' Club, Whitehall Rooms, Whitehall-place, S.W., 4 p.m. Mr. W. A. Haviland, "The Effect of the European War on Agriculture."

Asiatic Society, 22, Albemarle-street, 4 p.m. Pandit Shyam Shankar, "Some Issues Raised on the Chronological Assumptions in the History of Sanskrit Literature."

British Architects, Royal Institute of, 9, Conduit-street, W., 8 p.m. Opening Address by the President (Mr. E. Newton).

Tuesday, November 2...Sociological Society, at the Royal Society of Arts, John-street, Adelphi, W.C., 5.15 p.m. Mr. A. J. Toynbee, "The Non-Sovereign State: an International Problem."

Civil Engineers, Institution of, Great George-street, S.W., 8 p.m. Inaugural Address by the President (Mr. A. Ross).

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8.30 p.m.

Photographic Society, 35, Russell-square, W.C., 8 p.m. Mr. W. H. Smith, "Satista and other Platinotype Papers."

Anthropological Institute, 50, Great Russell-street, W.C., 5 p.m. Mr. H. J. E. Peake, "The First Siege of Troy."

Roentgen Society, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 8.15 p.m. Address by the President (Mr. J. H. Gardiner)

Wednesday, November 3...Chadwick Public Lecture, Royal Society of Medicine, 1, Wimpole-street, W., 5.15 p.m. Dr. R. O. Moon, "Typhus in Serbia." (Lecture III.)

Public Analysts, Society of, at the Chemical Society, Burlington House, W., 8 p.m. 1. Mr. W. H. Simmons, "Formic Acid as a Reagent in Essential Oil Analysis." 2. Mr. H. L. Smith, "Note on the Melting-point of Salicylic Acid, and a test for the presence of Para-hydroxybenzoic Acid." 3. Mr. E. Hinks, "The Persistence of Hydrogen Peroxide in Milk."

Royal Archæological Institute, at the Society of Antiquaries, Burlington House, W., 4.30 p.m. Mr. A. H. Thompson, "The Will of Master William Doune, Archdeacon of Leicester."

Geological Society, Burlington House, W., 5.30 p.m. Dr. C. W. Andrews, "The Discovery of a Fossil Elephant at Chatham."

Thursday, November 4...Chemical Society, Burlington House, W., 8.30 p.m. 1. Messrs. A. W. Knapp and R. V. Wadsworth, "Reactions between the higher fatty acids and salts of the lower fatty acids." 2. Mr. W. A. Davis, "The interaction of perchloric acid and potassium sulphate as an example of reversible change." 3. Messrs. G. M. and R. Robinson, "A decomposition of certain orthonitromandelic acids." 4. Mr. A. C. Sircar, "The relation between the chemical constitution and colour of azo compounds." 5. Mr. J. G. M. Dunlop, "3-gem-dimethyl piperidine." 6. Mr. S. U. Pickering, (*a*) "Compounds of iron, manganese, lead, and the metals of Group II", (*b*) "Valency." 7. Mr. J. C. Crocker, "The indirect determination of velocity of hydrolysis by the polarimetric method." 8. Messrs. M. P. Applebey and W. Hughes, "The vapour pressures of some saturated aqueous solutions."

Child Study Society, at the Royal Sanitary Institute, 90, Buckingham Palace road, S.W., 6 p.m. Miss C. E. Grant, "The American Child at School."

Automobile Engineers, Institution of, 21, Victoria-street, S.W., 8 p.m. (Graduates' Section.) Mr. T. D. Carpenter, "The Production of War Munitions by Motor-car Manufacturers."

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Miss G. Bacon, "Flying Machines in Peace and War."

Journal of the Royal Society of Arts.

No. 3,285. VOL. LXIII.

FRIDAY, NOVEMBER 5, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICE.

ARRANGEMENTS FOR THE SESSION.

The Opening Meeting of the One Hundred and Sixty-Second Session will be held on Wednesday, November 17th, when an address will be delivered by DUGALD CLERK, D.Sc., F.R.S., Chairman of the Council. The subject of the Address will be "English and German Methods Contrasted." The chair will be taken at 4.30 p.m.

The following arrangements have been made for the meetings before Christmas:-

ORDINARY MEETINGS.

Wednesday afternoons, at 4.30 p.m.:-

NOVEMBER 24.—SIR EDWIN PEARS, "Constantinople, Ancient and Modern."

DECEMBER 1.—THE MASTER OF CHRIST'S COLLEGE, CAMBRIDGE (Arthur Everett Shipley, Sc.D., F.R.S.), "Insects and War." SIR WILLIAM J. COLLINS, K.C.V.O., M.S., F.R.C.S., will preside.

DECEMBER 8.—LIEUT.-COLONEL W. A. TILNEY, 17th Lancers, "The Art of Finding your Way at Night without a Compass." DUGALD CLERK, D.Sc., F.R.S., Chairman of the Council, will preside.

DECEMBER 15.—J. JEF. DENYN, Carillonneur de Malines, and WILLIAM W. STARMER, F.R.A.M., "Carillons and Carillon Playing." (With illustrations.)

COLONIAL SECTION.

Tuesday afternoon, at 4.30 p.m.:—

NOVEMBER 30.—SIR SYDNEY OLIVIER, K.C.M.G., late Governor of Jamaica, "Recent Developments in Jamaica: Internal and External." SIR HENRY A. BLAKE, G.C.M.G., will preside.

INDIAN SECTION.

Thursday afternoon, at 4.30 p.m.:

DECEMBER 16.—C. C. McLEOD, President of the London Jute Association, "The Indian Jute Industry." SIR JOHN PRESCOTT HEWETT, G.C.S.I., C.I.E., will preside.

Papers to be read after Christmas:

LAWRENCE CHUBB, "The Common Lands of London: the Story of their Preservation."

REV. P. H. DITCHFIELD, "The England of Shakespeare."

W. A. CRAIGIE, M.A., LL.D., Joint Editor of the Oxford English Dictionary, "The Lexicography of the Arts and Sciences."

VICTOR HORTA, Directeur de l'Académie Royale des Beaux-Arts de la Ville de Bruxelles, "Belgian Architecture."

CHARLES DELCHEVALERIE, "Belgian Literature."

LESLIE URQUHART, "The Economic Development of Russia."

J. ARTHUR HUTTON, Chairman of the British Cotton Growing Association, "The Effect of the War on Cotton Growing in the British Empire."

S. CHARLES PHILLIPS, M.S.C.I., "Paper Supplies as affected by the War."

R. W. SETON-WATSON, D.Litt., "The Balkan Problem."

CHARLES R. DARLING, A.R.C.Sc.I., "Optical Appliances in Warfare."

COLONEL SIR THOMAS H. HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., late Survey of India, "The Romance of the Indian Ordnance Survey."

SIR DANIEL MORRIS, K.C.M.G., M.A., D.C.L., D.Sc., F.L.S., "The Timber Resources of Newfoundland."

PROFESSOR T. G. MASARYK, "The Slavonic Peoples."

PROFESSOR WYNDHAM R. DUNSTAN, C.M.G., M.A., LL.D., F.R.S., "The Work of the Imperial Institute for India."

INDIAN SECTION

Thursday afternoons at 4.30 p.m.:—

January 13, February 17, March 16, April 6, May 18.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 p.m.:—

February 1, March 21, May 2.

CANTOR LECTURES.

Monday afternoons at 4.30 p.m.:—

WALTER ROSENHAIN, D.Sc., F.R.S., Superintendent, Metallurgy Department, National Physical Laboratory, "Optical Glass and Optical Instruments." Three Lectures.

November 29, December 6, 13.

FOTHERGILL LECTURES.

Monday afternoons, at 4.30 p.m.:—

REV. DR. HERBERT WEST, D.D., A.R.I.B.A. (author of "Gothic Architecture in England and France"), "Flemish Architecture." Three Lectures.

February 7, 14, 21.

EDWARD A. REEVES, F.R.A.S., Map Curator, Royal Geographical Society, "Surveying." Three Lectures.

March 27, April, 3, 10.

J. ERSKINE-MURRAY, D.Sc., F.R.S.E., M.I.E.E., "Vibrations, Waves, and Resonance." Four Lectures.

May 1, 8, 15, 22

JUVENILE LECTURES.

These Lectures will be given on Wednesday afternoons, January 5 and 12, at 3 o'clock. The lecturer and subject will be announced later on in the *Journal*.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

HOUSE BUILDING: PAST AND PRESENT.*

By M. H. BAILLIE SCOTT.

Lecture II.—Delivered March 22nd, 1915.

In considering the houses of the past in this country, I want to try to pierce deeper than the mere external forms in which building expressed itself from time to time. I do not propose to speak of Early English work, or decorated, or perpendicular, or of tracery and pointed arches. All this morphology of the building periods has been exhaustively dealt with and exactly measured, tabulated and described. It is all extremely interesting, but not of great value unless we can get from the work some conception of the spirit that informed it. The building art is, like other arts, the medium for the expression of the individual or combined group of individuals who produced the work. What they sowed we may reap, no more and no less, and the spiritual appeal of a building represents the sum of the spiritual energy put into it by its builders the heart inspiring and the brain guiding the dexterity of the hand. I give this trinity of factors in the order of their importance. The most vital matter is the inspiration, the divine spark in the work; the brain gives rational guidance, and the hand is the medium of expression. If the true inspiration is there, we may forgive some lack of intelligence in the brain and halting powers in the hand. If some great thought is seeking expression the readiest and simplest language is the best. The knowledge which the brain can acquire and the skill which the hand can attain to are of little worth except as servants to the ideal, and the whole tragedy of the development of any art lies in the pride of knowledge and skill, in mere proficiency for its own sake, which reduces the whole art to the level of an acrobatic performance. If we consider the deeper significance of the art of building in the past, we shall find it divides itself naturally into three periods:-

First, the craftsman period extending from the earliest Gothic times, through the Middle Ages up to the time of the Renaissance.

Second, the scholar period dating from the Renaissance till about the end of the eighteenth century.

Third, the shopkeeper period, when the commercial ideals of the nineteenth century found their expression in building.

These three periods are not clearly defined by the dates referred to. Long after the Renaissance the earlier tradition of the craftsman lent warmth and colour to the work of the scholar period, and led to several curious phases in transitional blends, and after the end of the eighteenth century many curious manifestations of moribund scholarship occur.

There is always something childlike in the best kind of art, and one of the best definitions of art seems to me the one which describes it as the survival in man of the play instinct of the child. In the craftsman period we may

* All the houses illustrated are designed by the author.

FIG. 7.—"UNDERSHAW," GUILDFORD. (Entrance Front.)

FIG. 8.—"UNDERSHAW," GUILDFORD. (View from Garden.)

compare the builders to a happy eager band of children building castles on the seashore. They are working for the best of all motives, to please themselves. And so all goes well with them and their work. And then we may imagine the coming of the Renaissance in the person of some pompous and dignified professor who engages to teach these happy builders how their work ought to be done according to classic precedents. The children, somewhat crestfallen, are not unwilling to try a new game, and continue to extract some amusement for a time with quaint variations on the classic themes, but they gradually realise that the old happy holiday work is over, and lesson time and grammar has begun. But still they continue to find some pleasure in the school work which has been thrust upon them.

Then comes along the shopkeeper, who points out to the professor and his pupils that all this working for fun as the children did at first, or working according to rules set by the professor, is really not what is required at all. It isn't practical, and it doesn't pay. No; they must work for his profit, and nothing else really matters.

And so these children, who were once happy and free, first become scholars and now have become factory hands. Through endless hours of dull labour they do again and again the same tasks. All the romance and magic has faded out of their work, which is devoid of pleasure both to the producer and the beholder.

My conception, then, of the building period of the Middle Ages is just the opposite to that conveyed by the term generally applied to this period, the "Dark Ages." So far from that, the mediæval building period seems to me the daytime of art in building, and this conception does not rely on any delusive written records. It has been said of the historian that it is his privilege to narrate accurately what never occurred. My records are the actual buildings themselves, and my appreciation of these is not due in any degree to historical associations or the glamour of antique things. Good building is to me good building, in whatever century it may be produced; and no mere passage of time will sanctify bad and ignoble work, and will add little to the initial qualities of a building. And, indeed, one is apt to forget how much of the glories of the old buildings has passed away, and I like to think of the old house and the old church when the work in each was fresh from the hand of the workman, when the chancel screen was bright with gilt and colours, and when the house was gay with all its proper appointments, without the taint of modern trade art, which it is almost impossible to exclude nowadays. And if in modern building the methods of the old builders are advocated, it is not because they are the old methods, but because they are the right methods; and although the final result of their application will lead to a resemblance between the modern house built in the old way and the old house itself, that is merely because in both right principles have been followed. This is quite a different thing from servile imitation, or the unintelligent reproduction of characteristic features of the periods which we find displayed in the showrooms of the modern cabinet-maker. The Tudor room, with all the proper appointments of the period, including a suit of armour propped up in the corner and imitation beams in the ceiling, is no proper setting for modern life, and must necessarily appear an affectation to any sensible person. Many of the simpler features of the Tudor house may, indeed, be put into the crucible of the mind and distilled into a new harmony, subject to those necessary restrictions that the realities of modern life impose; but this is a different matter from the ordinary "period" room as it is called, which lacks reality and suggests the museum rather than the home.

If the mediæval building age may be considered as the daytime of the arts, we may continue the figure and think of the breaking up of the craftsman period as a time having the ripe and mellow beauties of the sunset. In the early part of the eighteenth century the last warm afterglow had faded from the sky, and after that nothing was left but the cold greyness of the later Renaissance, eventually succeeded by the darkness of the Victorian era, the true dark age of the building art. Since then, in modern times, we have had various little local dawns, but no new day has yet arrived on any comprehensive scale in the building world.

Of the three periods of building, then, that of the craftsman seems to me incomparably the best. The art of building during the craftsman period was the central and dominant art of the world, a kind of universal language expressing the ideals of the nation as a whole. To the simple, practical minds of the old builders it was sufficiently obvious that the proper function of art was in the creation of a world of buildings. Art was not a thing to be shut away in galleries and museums, but its proper sphere was a much wider one than that. It was no less than the

adornment of the whole world in which we live. Every village and every town was an artistic creation. From the broken and disfigured remains of this work we can form some faint conception of the beauty of the England thus created in the Middle Ages, when every house was in its degree a work of art in harmony with its natural surroundings. Nothing we structure. We find art here engaged in the service of life, and not, as in the modern world, divorced from life. Like the wanderer Maurice Hewlett writes of, who aimed at making England a garden, the artist of the Middle Ages aimed at beautifying the world with building. And I think we must all admit he succeeded well. For the beauty of England

FIG. 9.—"UNDERSHAW," GUILDFORD. (The Hall.)

have done since, nothing we can do now, is to be compared for a moment with the glory of that building art. It was a living force claiming for its expression the organised and combined efforts of a whole community of craftsmen. And it gives us an object lesson as to the true place of art in the world, primarily concerned with building, and interested in the accessory arts of painting and sculpture only so far as they served to clothe and adorn which still survives to us is not only a matter of the hills, the woods and the fields. We should love Sussex less, I think, and not more, if there were no old villages hidden in the folds of the downs, nor would the austere uplands of the Cotswolds delight us so much without their villages of pearly grey; and in every county we find the old buildings of the locality are not only in harmony with Nature, but they seem to accentuate and interpret its dumb appeal.

So intimately blended is the spirit of the old buildings with their natural surroundings that it would seem as if the same power that created the one had also inspired the production of the other, and so we find throughout the length and breadth of the land the old builder with his magic touch has created new beauties everywhere in village and town, in church and manor, in farmhouse and cottage.

The art of building, then, as practised during the time which I have called the craftsman period, not only successfully solved the practical problems of its day on the material plane, but in doing so it also created a world of beauty; and since we have now lost this art it seems useful to inquire into the methods of these old builders which led to such splendid results. I do not suggest that we should copy the outward aspects of these old buildings, or reproduce lifeless replicas of them, but that we should try to discern something of the heart of their mystery.

The virtue of building as an art does not lie in any particular outward forms. Tracery, cuspings, Corinthian columns, all the accumulated architectural lumber of the ages, are quite useless to us in themselves. The only thing that really matters is the spirit which inspires the producers of the buildings. Given a group of craftsmen, working not only for material gain but inspired by some noble ideal, and their work, in spite of themselves almost, will reveal to the discerning eye something of the quality of the spiritual force which created it. And so it is fitting, in considering the work of this craftsman period, we should go behind the forms in which it expressed itself, and try to discern something of the attitude of the workers engaged in it. In those days we shall find the members of each trade were combined in the form of Trades Guilds. These guilds were combinations of craftsmen for the purpose of building, and the most striking fact about them was that the bond which united them was not a money bond. In these brotherhoods of workers there was nothing equivalent to our system of capital and labour—of masters making profits and labourers taking wages. It is true that the material interests of the craftsman were looked after by the guild The livelihood of the members was secured whether they happened to be working or not. They were free then to work not merely to live, but for the honour and glory of their guild. That, and not mere cash payment, was the bond which held them together. Can we wonder then that their work was something radically different to modern building? The value of the knowledge they accumulated and bequeathed to their successors was of a kind which in these days of book learning we can perhaps hardly appreciate. It was instinctive rather than reasoned, and was a thing too subtle to be formulated by any words. The whole outlook of these old guilds was entirely different from any combination of labour in the modern world. If we take, for instance, the Guild of the Carpenters, we shall find that all the wealth produced by carpentry was in the hands of an organised association of carpenters. In such circumstances we may naturally suppose that carpenters would desire, amongst other things, to get some legitimate pleasure as well as profit out of their work. In existing conditions a shareholder in some factory where timber is ruthlessly dealt with by the machine, cares nothing about carpentry from the standpoint of the craftsman. It is a natural result of the system that he should care for nothing but dividends. If he is philanthropic he may go further, and be interested to know that the workers in the factory have good wages and dwellings. But he is perhaps hardly aware that the craft of carpentry, when practised in the old way, is capable of yielding quite another kind of dividend than that in which he is interested. I mean that joy in creative work which was not the least valuable part of the wages of the old craftsman. Until we can get work done again in the old way, and enlist the hearts and heads, as well as the hands, of every workman in our service, it is idle to hope that we shall produce any sort of building or architecture worthy of the name. Men do not gather grapes of thorns, or figs of thistles, and the ugliness of modern building is the inevitable and natural result of the ugliness of the methods that produce it. In a word, while the normal modern house is the confessed symbol of greed of profit, the old one stood for delight in work. And this delight in work was fostered by the guilds, and there was no outside power then to step in and say, "No, you are to work for my profit and not for your own delight."

I hope, then, I have been able to show that the fundamental cause of the beauty of the building in this craftsman period was the freedom of the craftsman to express all that was best in him in his work. He was something more than a cog in a profit-grinding machine. The civilisation to which he belonged had many faults, but it at least gave the workmen such opportunities as they do not enjoy to-day.

Fig. 10.—Cottages at Gidea Park, Romford. (View from Road.)

Fig. 11.—Cottages at Gidea Park, Romford. (View from Garden.)

I have no wish to pose as a reformer, and I have no "Morrison's Pill" to cure the ills of the labour world; but I cannot help wishing that, when we once more turn our minds to the arts of peace, some organisation of labour, modelled on the old Trades Guilds, may be attempted as the first step to secure some real revival of the art of building. In such organisation the architect must take his place, not as an alien superior person, but as one so intimately associated with labour that he can interpret its dreams in terms his fellow-workmen can appreciate and understand.

The main interest of the old guilds was the building of churches, but when they built the houses which were to enshrine their domestic life they did not adopt a different style of building. Church and house were alike in their main characteristics, and in the creation of each the craftsman found, in a world of wonders not yet classified and defined, opportunity to realise in brick and stone the creations of his fertile imagination. In such conditions, and in such an atmosphere, it is not to be wondered at that the building art of the crafstman flowered into beauty. Much of it, fortunately, has survived to the present day, and from the study of these old houses much may be learnt. If we examine sympathetically an old building of the craftsman period, we shall find that the whole of the fabric seems to be saturated with a kind of human warmth of life, and the unconscious art of it does not lie in any cleverness or feats of skill, but in a glowing warmhearted vitality which seems to permeate it. The whole technique of its workmanship differs materially from modern practice, and such merits as it possesses depend to no small extent in the way in which the work is done.

The great principle which seems to have been unconsciously divined by these old builders is that each material used has its peculiar qualities, and in its handling these qualities are to be recognised and developed. Thus, the bricks in the walls are patently made of burnt clay. That is to say, in their surface and outline they have the kind of surface and outline which belongs to burnt clay and to no other material, and their life history is still further recorded in the varied clouding and colouring of the fire. And the bricks are sensibly arranged without any unnecessary time wasted in making them exactly regular. The eye of the workman guides his hand without any mechanical aids, and so the work becomes a human document—becomes almost as characteristic as handwriting. And then when we consider the timber we shall find the same discernment in its treatment. In a material which has a distinct grain, and which gives us a distinct and characteristic surface when chipped with an adze or chisel, it seems that the real qualities of the timber can best be developed by such workmanship. Again, in the treatment of wrought iron, we find the forms of the metal chiefly valuable as illustrating the fact that though now cold and hard, in passing through the fire it was soft and ductile. In the plaster the same hint as to character will be given, and it will appear like a lava stream which has flooded the walls, flowed round the timbers, and so at last became frozen. And all the subtle differences of texture in surfaces and outline, arising from this kind of craftsmanship, will come about, not for the love of irregularity for its own sake but for the sake of expressing the individual character of each material. Anyone who has engaged in any kind of craftsmanship must have experienced that kind of will-force which a material, such as timber for instance, possesses. You may lead it gently in one direction, but only by force can it be made to go in another. The craftsman, then, can either impose his will relentlessly and crush the individuality of the material with a mailed fist, or he can allow the expression of its character. In the old work it was the latter method we shall find followed, and all the mouldings and carving in old oak, for instance, seemed to gain their chief value, not from any special beauty of line or contour, but from the way in which they seemed to explain and emphasize the qualities of the material. It is the same sort of commentary as we have noted in the building itself in relation to Nature. The old house seems to say, "All these fields and woods which surround me have a message and a meaning. That message and meaning I can convey to you for I am in the secret." And so the carved and moulded panel of some old oak chest: "Behold me; I am English oak. See how my knotted grain has deflected the chisel. I am subdued and disciplined to my place in the world, but my character and individuality still remains."

All these qualities of old work which I have endeavoured to indicate are not difficult to obtain. They arrive automatically if work is done simply and naturally. To smooth away all the character from a piece of oak till it might be mud, or cheese, or anything, is quite a tedious process, and indeed is generally the

outcome of pride in command over tools—the pitfall which seems always to await every school of craftsmanship. We must give up all such pride of mastery; for good workmanship, like good government, must seek to understand the true character of its subjects, and yield room for the due expression of that character. If then we consider the craftsman as the ruler of a kingdom, in which each material is given its appointed task and allowed in the doing of it the proper expression of its qualities, we shall find the cumulative result in the building, of little isolated tasks rightly done, beyond all our expectations.

It is difficult to put into words the effect of an old house of the craftsman period on the mind of the sympathetic observer. We may be moved to delight by pictures and all the stored treasures of the past to be found in our museums. We admire all these things, but perhaps go away from them with a confusion of the mind and a headache. We are dimly conscious that there is something wrong, and that art should not be jumbled into galleries and museums, but form the proper setting of our lives. But in the old house we find the real thing that our fathers knew. We are enveloped at once in an atmosphere of peace. We are snatched away from transitory frivolities and all the superficial unrest of modern life. The walls seem to breathe out healing virtue, and as we pass from room to room we recognise that here indeed is the mistress art, compared with which all other arts are vain.

In leaving the consideration of the craftsman period for that of the scholar period at the time of the Renaissance, we are taking the first step on the downward path which ended in the lowest depths of the Victorian era.

Fig. 12.—Cottages at Gidea Park, Romford. (View from Road.)

In the craftsman period, house building was essentially a creative art, and all its forms were the expression of definite functions. A beam was placed to carry weight, a buttress to resist pressure. But when the Renaissance introduced to our builders all the features of classic architecture, a new principle of imitative art was introduced. At first the impetus of the tradition of the guilds prevented any serious damage, and the quaint use of the new forms by the craftsman of England was not without its charm; while the prim scholarship of the style of building thus developed was saved from

dullness and pedantry by the human qualities of the earlier tradition. But still, by slow degrees, the whole business of building became hardened into formula; the creative artist gradually became specialised in the accessory arts, and the downfall of building as an art was complete. In the buildings of the craftsman period all the forms used were those which the creative intelligence of the builders had devised to meet the requirements of structure, without reference to buildings created for other purposes and other climates. The whole form of the plan was conditioned mainly by the building up of its component apartments in their required positions, and as the occasion demanded the building took upon itself various forms. But when the Renaissance came, and men began to look back and imitate externals, it became the custom to think of the house as a rectangular symmetrical box, in the four walls of which had to be packed the multitudinous apartments which a more advanced civilisation demanded. In the struggle which ensued, symmetry generally broke down somewhere, and it was necessary to help it out with the sham window and other devices. This kind of building was most at home in the town, where the rectangular outline of the plan was logical; but in the country the rambling and irregular forms of the earlier buildings were more appropriate and more in harmony with their natural surroundings. The main drawback to the Renaissance work, however, was that it destroyed the creative initiative of the craftsman. All the freedom and vitality which was the mark of the earlier work was strangled in the grasp of the classic pedants. Building, as the universal vernacular speech of the many, was superseded by architecture, as the stilted scholarly utterance of the few; and all the organised bodies of craftsmen became despoiled of their heritage of creative work, and became the mere lackeys of the designer of the building who lived in another world than theirs. The architecture thus developed was no longer the logical expression of actual structure. It was a matter of externals; and so all the realities of the building became degraded to the dismal science expounded in the current text-books.

In the craftsman period it was rare indeed to find any feature in a building which was not the immediate outcome of function. Utility was the foundation on which the whole structure was based, and though it soared above it in many expressions of fancy, the sure foundation was always there justifying its highest flights. But when the Renaissance led our builders to copy the external features of the buildings of Rome, the cart was put before the horse, and the particular function, instead of creating its own inevitable form, had to make the best it could of forms which had originally expressed quite different purposes. Once the habit of copying foreign buildings was established, it quickly tired of the buildings of Rome and passed on to Greek art. Then Gothic work was discovered, and duly imitated in its turn. And so our architects passed from style to style with growing dissatisfaction. Each new adventure became in turn old-fashioned, and it was always the latest enterprise which was going to be the right thing at last. But still the glory that was Greece and the soul of Gothic art alike proved too elusive to be captured. Each belonged to its own time and to no other, and found no place in the modern world. The great glory of Greek and Goth was that they created Greek and Gothic buildings. It was nothing to the credit of the modern architect to imitate these creations. He might as well have imagined he could emulate Shakespeare by copying a page from one of his plays.

And while our architects were busy with all these futilities, gradually whatever practical structural ability we were producing was specialising itself in engineering, while artistic genius was devoting itself to painting and sculpture. The building art became drained of its best blood, and the production of houses, the most vitally important function of the community, became, as it remains to-day, the almost exclusive field of the speculative builder. And as in the Victorian era the last breath of the earlier tradition expired, the English house touched its lowest depths. We have not to go far to find plenty of examples of these houses, with their dark basements and lofty reception rooms--harsh cold and repellent—without one touch of human handicraft. To follow the progress of house building through the nineteenth century is a sorry task. One is reminded of the old story of the tower of Babel, when the building was obstructed by a confusion of tongues. On the one hand was the architect, with his enthusiasm for reproductions; on the other, the craftsman without any enthusiasm at all. Architect and craftsman lived in different worlds, and spoke different languages; and so the architect always found in some disconcerting way that his modern house, built on the model of the old, was never the least like it. The old was always better, because it was

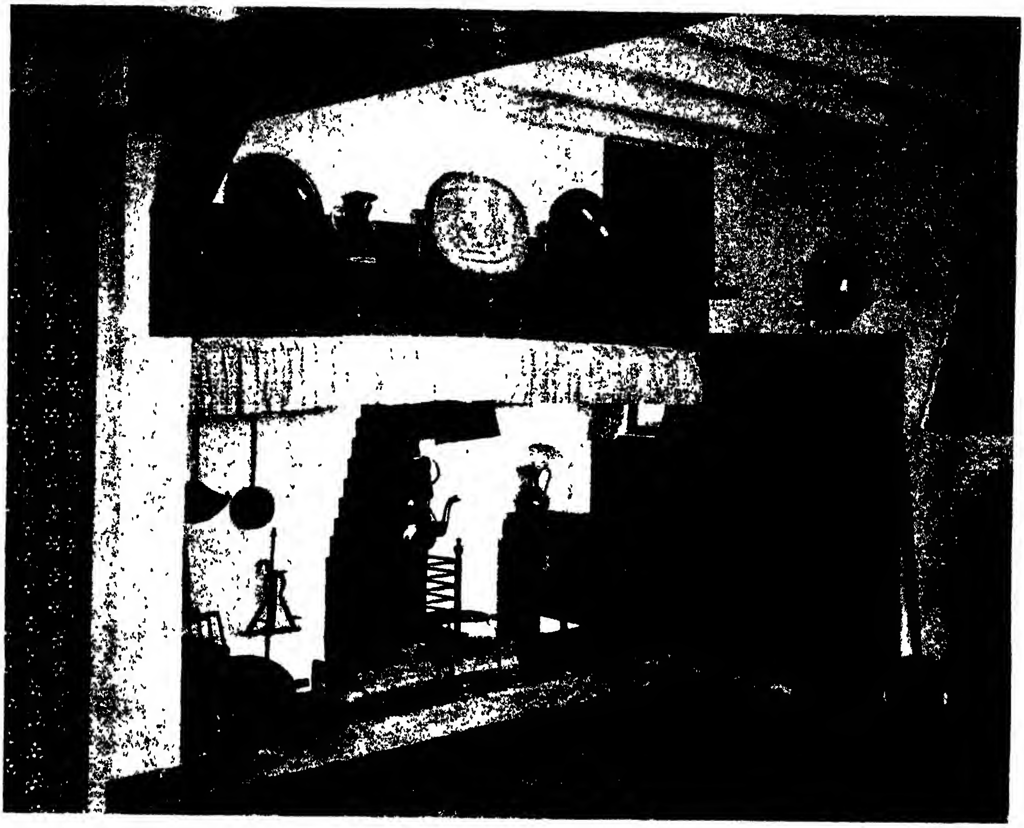

FIG. 13.—COTTAGES AT GIDEA PARK, ROMFORD. (Living Room Fireplace)

produced under entirely different conditions, and was a spontaneous and unique expression of its time.

I can liken the buildings so produced to nothing better than waxworks. They reproduced external forms, but could not supply the vital spark. The builders went through the motions of building, and gave us all the correct external forms. But they could not give us the one thing needful to make their dry bones live.

·TWO COTTAGES at GIDEA PARK·ROMFORD·ESSEX

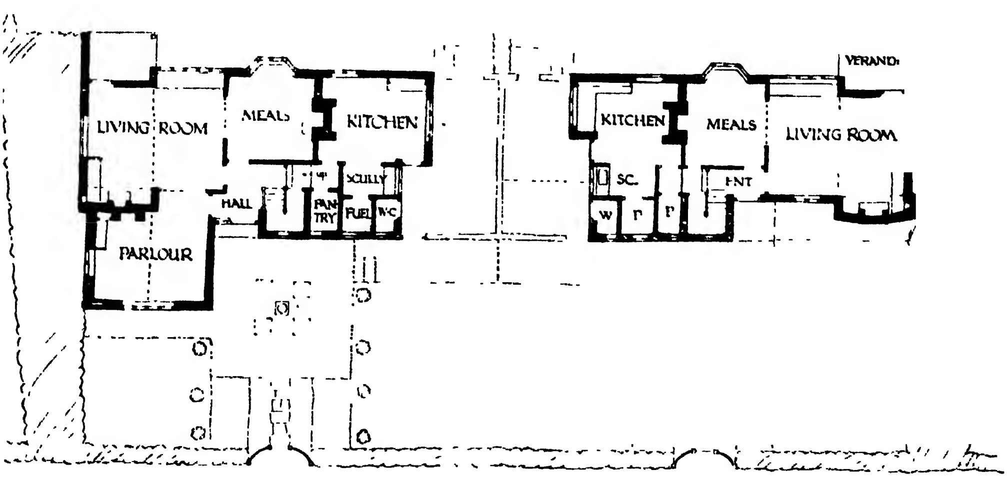

FIG. 14.

THE DEVELOPMENT OF THE TEXTILE INDUSTRIES.

The Textile Institute.—It cannot be said that the discussion upon education at the Huddersfield Conference of the Textile Institute exhausted all the views that manufacturers are known to entertain upon that subject. They are popularly understood to suffer from a certain illiberality of ideas, but it was a manufacturer who intervened against a scientist to prevent the Institute from seeming to asperse the advantages of a classical education. The interposition gives a reminder, if it were needed, that the manufacturing classes include men of widely different antecedents and outlook upon life. Another manufacturer, speaking purely of cases within his own knowledge, avowed that three out of four of the parents who take their children earliest from school, have no genuine need of the money brought in by their offspring. A discussion ranging over the higher, lower and technical education failed to show that any one coherent idea of how these matters should be administered or reformed commands the industrial m'nd. The arguments that education is more necessary now than ever; that money must not be grudged to it; that changes must be made and a multiplicity of counsellors called in, are of course not new ones. They were advanced with emphasis and cogency, but a more detailed examination of the considerations involved might reasonably have been looked for. There is nothing, however, to suggest that the Institute has done with the subject, and it is the fact that the new problems and certain definite proposals engage the minds of those who do the collective thinking for the textile trades.

Industrial Education.—It is at all events probable that manufacturers will continue to follow diverse courses in the education of their sons; some sending boys destined eventually for the mill to the public schools and old universities, and others equally able to support the cost of a liberal education putting their boys into the mill at some such age as seventeen. Good industrial and commercial results have been obtained by both methods, and both of course have furnished disappointments. A not too distant analogy can be found in the action of those who send their sons for a few years to the technical schools or new universities, and the others who insist upon mill training by day and school training by night. Where so much latitude prevails general rules are not easy to draw, but it would seem that, upon the whole, manufacturers are disposed to look on mill work as the larger part of an industrial education. In one way and another manufacturers have had a good deal to do with the shaping of the technical education imparted in the textile districts, and for any defects in it they must bear a share of the blame. Educational systems being in their nature things in which final perfection is never reached, dissatisfaction with them can never be absent. Late years have seen a great addition to the plant and apparatus of the textile schools, and a great increase in the number of persons receiving tuition. What is not so clear is that quality has kept step with quantity. Judgment is not easy to make, and certainly cannot be formed upon a consideration of *matériel* alone. It would appear that in technical, no less than general education, the individuality of the teacher counts for a very great deal, and it may be the case that individuality has less play in these days than in times when technical education was less systematised. The opinion is one that is found to exist.

Industry and Finance.—The conflict between industry and finance is not so marked and open as the old one between labour and capital, but it is responsible for an occasional explosion of feeling. The conflict is the same, although the plane is a different one. The industrialist, or workman, is conscious of the worth and necessity of his work, and the financier, capitalist, or shareholder looks out on a horizon bounded simply by profits. The conflict is passably reconciled where the parts of captain and capitalist are doubled by the same person, and it breaks out the more clearly the more the separation is defined. There are no grounds for thinking that the old relations between working partner and sleeping partner in the private firm were untinged with acrimony. Assuredly there have been moments of tension between the private employer and his backer, the manager of the bank. The financial press has some responsibility for a bitterness of feeling exhibited between managers of industrial undertakings and public shareholders. A tone of insolence, even when diluted by tell-tale signs of ignorance, does not tend to promote cordiality of feeling, and it is undeniable that grossly contemptuous airs have been shown towards men who have for any reason failed to report the accustomed dividend. Sir William Mather, a week or two ago, spoke of the misfortune that brought industry within the control of those who only understood stocks and shares, and could only decide by dividends whether a company was worth continuing or not. The words are the new paraphrase of the intense conviction in textile quarters that "brains are worth more than brass."

The Enemy's Raw Materials.—Such information as filters through from Germany goes to show that the quest for new textile fibres of home production has been fruitless. The hop-bine, the willow-weed, nettle fibre, broom, and the rest of them, have apparently proved as unsatisfying as might have been fairly expected, and the later rumour that a means has been found of spinning wood fibre can be received with all reserve. A German mill-manager who has been driven back upon the wisdom of the ages, counsels his countrymen to plant hemp and flax, the one as a substitute for jute and the other for cotton. Given seed, both can be had by waiting, and shift can doubtless be made to convert them into yarns and fabrics

generally less suitable for their purpose than the originals. A noticeable silence has come over the reporters upon the condition of German textile industry, and in view of the increased restrictions upon the sale of textile goods the inference is that the suffering is growing extreme. Reliable reports state that a prepared cellulose obtained from wood and called "lignin" has a large sale in Germany in place of the usual surgical lint of absorbent cotton-waste. In Sweden also a cellulose wadding for wounds is being made in sheets resembling crinkled paper. Probably enough, cellulose yarn made by twisting ribbons of paper finds a more extended employment in Germany than it did when jute was available in its place. The increased pains taken by the British Government to prevent raw or manufactured textile supplies are reflected in one trifle that has not been reported, as well as in the regulations which make it difficult to export cottons to European ports. The woollen cloths sent out to Berlin from this country for wear by British prisoners are of a colour to make them useless to German troops. These goods have been dyed black.

Dyestuff Manufacture.—A committee has been formed, representative of dyers in all trades, to consult with the Government departments responsible for the provision of dyestuffs, and for the supply of materials and reagents necessary for the manufacture. New makers of dyestuffs are springing up in some number, and the suggestion is abroad that various new and large works erected primarily for explosives will ultimately turn to the colour trade. A site for the new factories of British Dyes, Ltd., has been found on 250 acres of land at Huddersfield, where there are good rail and water transport, soft and abundant water, and adjacent supplies of coal. Contracts for construction amounting to £250,000 have been let, so that in one way and another the dyeware supply is being advanced. Perhaps for a long time to come there will be a scarcity of particular colours, a scarcity which exhibits itself conspicuously in matters of price. It is the case, for example, that a cotton dyer, wanting an especial colour for which he habitually paid 10½*d.* per lb., had to pay 45*s.* per lb. for his material.

Systems of Price-Maintenance.—Price-maintenance compacts between manufacturers of textile goods are not wholly unknown, but for special reasons they are not as common, or perhaps as necessary, as in some other trades. The makers of goods see something of the manœuvring of others who are parties to bargains aiming at keeping up prices to them. On the whole, their objection may be less to the successful scheme, always assuming it not to be extortionate, than to the compact which results in letting some have services or supplies at more favourable rates than others. There is, at any rate, a running warfare between manufacturers and the members of various price associations. One of the commonest ways in which these undertakings are circumvented is by the all-round price. The association issues its quotations showing different prices for different services, and the disloyal member offers to undertake all the work that is sent to him at a fixed or median price. The details are beyond supervision, and the customer who bargains well fares better than the one who pays the scale rates. Even allowing for such breaches, it is possible that the compact is better than none at all from the standpoint of those who enter into it; but the process of breaching is self-destructive in the end. In the United States an alternative method, which may not be actually bomb-proof, has been introduced with some success. The members of the ring quote prices as they think fit, and communicate their quotation to a secretary who circulates them throughout the membership, or even throughout the trade. The method seems, at first blush, to facilitate matters for those whose simple system is to take business by offering terms a little lower than any others. Pursued far enough that process leads to mutual extermination and it is necessary to take into account the counter-attraction of the market price. In performing the same or better services than A, the competitor B is not satisfied permanently unless he obtains at least A's price for the same work. There is a competition to secure good prices that is to the full as real as the competition to obtain work, and if this open-price system survives a protracted trial its success must be attributed to the opportunity given to upward as well as to downward driving. The operation is not actually more wonderful than that taking place in auction rooms, where buyers, whose common interest is to buy cheaply, find themselves forcing up prices against each other.

OBITUARY.

Sir Thomas Fowell Buxton, Bt., G.C.M.G.—Sir Thomas Fowell Buxton died on October 28th at Colne Cottage, Cromer, the residence of his son, Mr. Noel Buxton, M.P. He was born in 1837, and was educated at Harrow and Trinity College, Cambridge. Upon the death of his father, Sir Edward North Buxton, he became third baronet in 1858. He entered Parliament as member for King's Lynn in 1865, but he only retained his seat till 1868. For many years he took a deep and active interest in the work of the British and Foreign Anti-Slavery Society, and was its President since 1899. Like his brother, Mr. Edward North Buxton, he was a Verderer of Epping Forest. He was a warm supporter of the Volunteer movement, serving as Colonel of the Second Tower Hamlets from 1864 to 1883, and as honorary Colonel from 1884 to 1903. In 1895 he was appointed Governor of South Australia, an office which he held till 1898. In 1899 he was created a G.C.M.G. in recognition of his services in the Commonwealth.

Sir Fowell's connection with the Royal Society of Arts dates from 1875, when he took the chair at

a meeting of the African Section, which has since become the Colonial Section. The paper on that occasion was "Livingstone's Discoveries in Connection with the Resources of East Africa," by the Rev. Horace Waller. From that time Sir Fowell continued to take a warm interest in the work of the Society. He became a member in 1879, and in 1903 was elected to the Colonial Section Committee, on which he continued to serve to the time of his death. On several occasions he presided at the Society's meetings, and he frequently took part in the discussions, being particularly interested in subjects connected with Africa and Australia.

GENERAL NOTES.

German Trade in India.—The *Englishman* gives some particulars of a scheme set on foot in some native states of Central India to rescue the lac trader and some of the hide traders from German and Austrian clutches, and to raise the standard of Central Indian hides which, under the description of Rewah hides, had a bad name. The scheme has received the sanction of the Government of India. The new organisation is the result of several years' hard work, and is already making its way in the home markets, though to nothing like the extent to which it should presently develop, for the organisation now covers the territories of eight native states of some 10,000 square miles, an area considerably greater than the principality of Wales. In view of the needs of tanners in England, the Association is already busy on tanning products, of which there are unlimited quantities in Indian forests. The states concerned in the undertaking are Nagod, Manihar, Baraundha, Jaso, Taraun, Panna Chhatarpur, and Datia in Baghelkhand and Bundelkhand, while Ajaigarh and Bijawar will probably join. They have formed a company named the "Esociet," which is short for "Eastern States of Central India Export Trust," with a capital of three lakhs. The states are represented on the board of directors. "Industrial development," says a memorandum on the scheme, "is recognised as one of the great needs of this country, and it is confidently believed that this scheme will be of immense benefit to the states concerned, and particularly to the smaller states now solely dependent on agriculture, whom it should raise to comparative affluence and relieve of much of the anxiety inseparable from the present precarious source of their income."

The Canals of China.—The canals of China are one of the wonders of the country. The Grand Canal, which is nearly 1,000 miles in length, was begun in about the sixth century B.C., but was not completed until 1283 A.D. Of late years this magnificent waterway has been neglected, and its value for navigation purposes has greatly diminished. There is no reason, however, if adequate funds were provided and judiciously expended, why the Grand Canal should not again become an important factor in transportation in China. While the Grand Canal appeals to the imagination by reason of its great length, the canal systems of the provinces of Chekiang and Kiangsu are really more wonderful. In an area ·175 miles by 160 miles there are no less than 25,000 miles of canals. Travellers by the Shanghai-Nanking Railway and the Shanghai-Hangchow Railway are amazed by the number of canals that are crossed each mile. Along these flows a steady stream of traffic, sometimes a number of heavily laden house-boats towed by a diminutive steam launch, sometimes an old-style craft propelled by a stern-oar. More than 4,000 years ago Yu, who afterwards became Emperor, inaugurated the system of canalisation that obtains in China to-day, and compensates for the absence of roads. Even when the vast programme of railway construction that has been decided upon is carried out, the canals will continue to be a most important factor of traffic between districts. They will not compete with, but feed the railways.—*Manchester Guardian China Number.*

MEETINGS FOR THE ENSUING WEEK.

Monday, November 8...Brewing, Institute of (London Section), Imperial Hotel, Russell-square, W.C., 8 p.m. Mr. E. B. Collier, "Notes on the Designing of a New Brewery."

Surveyors' Institution, 12, Great George-street, S.W., 8 p.m. Opening Address by the President, Mr. J. J. Hanson.

Tuesday, November 9...Photographic Society, 35, Russell-square, W.C., 8 p.m. Presidential Address.

Zoological Society, Regent's Park, N.W., 8.30 p.m. 1. Dr. G. E. Nicholls, "Some Notes upon the Anatomy of *Rana tigrina*." 2. Dr. J. C. Mottram. (*a*) "The Distribution of Secondary Sexual Characters amongst Birds, with relation to their liability to the Attack of Enemies", (*b*) "Some Observations on Pattern-blending with Reference to Obliterative Shading and Concealment of Outline." 3. Mr. C. Boden Kloss, "On a Collection of Mammals from the Coast and Islands of South-east Siam, with an account of the Fruit-bats by Dr. Knud Andersen." 4. Professor W. J. Dakin, "Fauna of West Australia.—III A new Nemertean—*Geonemertes dendyi*, sp. n.—being the first recorded Land Nemertean from Western Australia. IV. *Palæmonetes australis*, sp. n., being the first record of the Genus in Australia."

Wednesday, November 10...Automobile Engineers, Institution of, at the Royal Society of Arts, John-street, Adelphi, W.C., 8 p.m. Mr. J. H. Dickenson, "The Choice of Steel for Use in Automobile Construction."

Biblical Archæology, Society of, 37, Great Russell-street, W.C., 4.30 p.m. Professor L. W. King, "Recent and Future Work in Mesopotamia."

Chadwick Public Lecture, at the Royal Society of Medicine, 1, Wimpole-street, W., 5.15 p.m. Mr. A. Saxon Snell, "Emergency Military Hospital Construction."

Literature, Royal Society of, 2, Bloomsbury-square, W.C., 5 p.m. Professor W. de la Mare, "Ghosts in Fiction."

Thursday, November 11...Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mrs. J. H. Harris, "Tramping and Canoeing in Central Africa."

Auctioneers' and Estate Agents' Institute, 34, Russell-square, W.C., 5 p.m. Mr. S. A. Smith, "War Risks to Property."

Friday, November 12...Astronomical Society, Burlington House, 5 p.m.

Journal of the Royal Society of Arts.

No. 3,286. VOL. LXIII.

FRIDAY, NOVEMBER 12, 1915.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

EXAMINATIONS.

In pursuance of the announcement in the Examination Programme for the current year, the Council have decided not to offer the usual money prizes in connection with the examinations for 1916. They are, however, enabled, by the liberality of the Court of the Worshipful Company of Clothworkers, which has renewed the grant it has hitherto voted for certain special prizes, to continue the offer of Medals under the usual conditions.

As there will in future be no first or second prizes, the order of the award of the Medals will be stated. The number of those awarded in the larger subjects may be slightly reduced.

ARRANGEMENTS FOR THE SESSION.

The Opening Meeting of the One Hundred and Sixty-Second Session will be held on Wednesday, November 17th, when an address will be delivered by DUGALD CLERK, D.Sc., F.R.S., Chairman of the Council. The subject of the Address will be "English and German Methods Contrasted." The chair will be taken at 4.30 p.m.

The following arrangements have been made for the meetings before Christmas:

ORDINARY MEETINGS.

Wednesday afternoons, at 4.30 p.m.

NOVEMBER 24.—SIR EDWIN PEARS, "Constantinople, Ancient and Modern." COLONEL SIR THOMAS H. HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., will preside.

DECEMBER 1.—THE MASTER OF CHRIST'S COLLEGE, CAMBRIDGE (Arthur Everett Shipley, Sc.D., F.R.S.), "Insects and War." SIR WILLIAM J. COLLINS, K.C.V.O., M.S., F.R.C.S., will preside.

DECEMBER 8.—LIEUT.-COLONEL W. A. TILNEY, 17th Lancers, "The Art of Finding your Way at Night without a Compass." DUGALD CLERK, D.Sc., F.R.S., Chairman of the Council, will preside.

DECEMBER 15.—J. JEF. DENYN, Carillonneur de Malines, and WILLIAM W. STARMER, F.R.A.M., "Carillons and Carillon Playing." (With illustrations.)

COLONIAL SECTION.

Tuesday afternoon, at 4.30 p.m.:—

NOVEMBER 30.—SIR SYDNEY OLIVIER, K.C.M.G., late Governor of Jamaica, "Recent Developments in Jamaica: Internal and External." SIR HENRY A. BLAKE, G.C.M.G., will preside.

INDIAN SECTION.

Thursday afternoon, at 4.30 p.m.:

DECEMBER 16.—C. C. MCLEOD, President of the London Jute Association, "The Indian Jute Industry." SIR JOHN PRESCOTT HEWETT, G.C.S.I., C.I.E., will preside.

Papers to be read after Christmas:—

LAWRENCE CHUBB, "The Common Lands of London: the Story of their Preservation."

REV. P. H. DITCHFIELD, "The England of Shakespeare."

W. A. CRAIGIE, M.A., LL.D., Joint Editor of the Oxford English Dictionary, "The Lexicography of the Arts and Sciences."

VICTOR HORTA, Directeur de l'Académie Royale des Beaux-Arts de la Ville de Bruxelles, "Belgian Architecture."

CHARLES DELCHEVALERIE, "Belgian Literature."

LESLIE URQUHART, "The Economic Development of Russia."

J. ARTHUR HUTTON, Chairman of the British Cotton Growing Association, "The Effect of the War on Cotton Growing in the British Empire."

S. CHARLES PHILLIPS, M.S.C.I., "Paper Supplies as affected by the War."

R. W. SETON-WATSON, D.Litt., "The Balkan Problem."

CHARLES R. DARLING, A.R.C.Sc.I., "Optical Appliances in Warfare."

COLONEL SIR THOMAS H. HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., late Survey of India, "The Romance of the Indian Ordnance Survey."

SIR DANIEL MORRIS, K.C.M.G., M.A., D.C.L., D.Sc., F.L.S., "The Timber Resources of Newfoundland."

PROFESSOR T. G. MASARYK, "The Slavonic Peoples."

PROFESSOR WYNDHAM R. DUNSTAN, C.M.G., M.A., LL.D., F.R.S., "The Work of the Imperial Institute for India."

INDIAN SECTION.

Thursday afternoons at 4.30 p.m.:—

January 13, February 17, March 16, April 6, May 18.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 p.m.:

February 1, March 21, May 2.

CANTOR LECTURES.

Monday afternoons at 4.30 p.m.: —

WALTER ROSENHAIN, D.Sc., F.R.S., Superintendent, Metallurgy Department, National Physical Laboratory, "Optical Glass." Three Lectures.

Syllabus.

LECTURE I.—NOVEMBER 29.—Comparison of optical with ordinary glass—Defects and properties of glass for optical purposes—Transparency—Colour—Bubbles and defects—Striæ or veins—Internal strain and annealing—Hardness and durability—Testing of optical glass—The optical properties of glass—Refraction and dispersion—Their relation in crown and flint glasses—Glasses introduced by Schott and Abbe—Partial dispersions and the secondary spectrum—Apochromatic glasses and lenses.

LECTURE II.—DECEMBER 6.—History of optical glass manufacture—Fraunhofer, Guinand, Feil, Bontemps, Chance—Schott and Abbe—Hopkinson and Stokes—Efforts in England. The present method of optical glass manufacture—The furnace—The pot—Production and treatment—The process of melting and fining—Stirring and finishing—Cooling—Breaking up, selecting and moulding—Annealing—The final form of the glass.

LECTURE III.—DECEMBER 13.—The present process of manufacture—General difficulties—Costliness Cost of the pot—Time of production—Cost of melting—Raw materials—Low yield of good glass—Risks of the process—Risks of loss during melting Failures due to striæ—Risks of contamination—Errors and variations of optical constants—Range of glasses demanded by opticians—Small quantities required—Need for large stock of optical glass. Special difficulties in England—Cost of raw materials and of labour—Refractories. Special difficulties connected with "new" glasses—Their chemical activity—Action on pots—Absorption of colouring impurities—Attainment of extreme optical properties. Need for research—The general problem—How to make good optical glass—Necessary improvements in pots and refractories, and in furnaces and methods of working—Utilisation of new materials and electric methods—The special problems relating to individual types of glasses—Optical and other properties to be realised simultaneously—The limitations of possible glasses—Optical properties of crystalline media—Future possibilities.

FOTHERGILL LECTURES.

Monday afternoons, at 4.30 p.m.:—

REV. DR. HERBERT WEST, D.D., A.R.I.B.A. (author of "Gothic Architecture in England and France"), "Flemish Architecture." Three Lectures.

February 7, 14, 21

EDWARD A. REEVES, F.R.A.S., Map Curator, Royal Geographical Society, "Surveying." Three Lectures.

March 27, April, 3, 10.

J. ERSKINE-MURRAY, D.Sc., F.R.S.E., M.I.E.E., "Vibrations, Waves, and Resonance." Four Lectures.

May 1, 8, 15, 22.

JUVENILE LECTURES.

These Lectures will be given on Wednesday afternoons, January 5 and 12, at 3 p.m. The lecturer and subject will be announced later on in the *Journal*.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Monday afternoon, the 8th inst. Present:—

Sir Steyning William Edgerley, K.C.V.O., C.I.E., (Chairman of the Committee), Sir Arundel T. Arundel, K.C.S.I., Sir M. M. Bhownaggree, K.C.I.E., William Coldstream, B.A., I.C.S. (retired), Sir William Duke, K.C.S.I., K.C.I.E., Right Hon. Sir Henry Mortimer Durand, G.C.M.G., K.C.S.I., K.C.I.E., Sir Frederic W. R. Fryer, K.C.S.I., Sir Frederic S. P. Lely, K.C.I.E., C.S.I., Sir John Ontario Miller, K.C.S.I., R. A. Leslie Moore, I.C.S. (retired), Colonel Charles Edward Yate, C.S.I., C.M.G., M.P., with S. Digby, C.I.E. (Secretary of the Section).

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

HOUSE BUILDING: PAST AND PRESENT.*

By M. H. Baillie Scott.

Lecture III.—Delivered March 29th, 1915.

In my last lecture I tried to indicate some of the qualities of the building of the past in this country, emphasizing the fact that building was then almost invariably an added beauty to the world of nature. If we now turn from these old buildings to those of the modern world, we shall find a radical change has taken place in this respect. Building, instead of being, as a matter of course, an adornment of the world, has now become generally recognised as a deplorable but necessary disfigurement. When some country district is invaded by modern houses, we all lament the spoiling of its beauty. So it comes to this. Old building beautified the world; modern building spoils and disfigures the world. I know there may be those who do not think this important, but I believe it is quite wrong to think of beauty in building as a kind of luxury we can do without, which only affects the susceptibilities of a few fastidious artistic persons. If that were the right view, it would ill become me to be speaking of such matters in these days. But my chief concern about building is not so much from the point of view of the observer as of the producer. And I believe that beauty in building is the natural outcome of healthy and happy work, and that while the production of beauty naturally is a sign of health of the spirit, the production of ugliness is a sure sign of disease.

I am, of course, aware that, besides the commercial buildings of to-day, there are some brave attempts now being made to build in a better way. These attempts are, however, quite isolated and sporadic, and count for little in comparison with the bulk of modern house building. And those who attempt to apply right principles to modern building find their way beset with difficulties, for of building considered as an art the modern builder knows little. His whole outlook, and the whole training of his men, has been towards an ideal of mechanical perfection. The best kind of brickwork, from his point of view, is a wall of perfectly regular and evenly coloured bricks; the best kind of roof tiling consists of tiles of exactly similar shape, size and colour, in faultlessly even rows. To ask the modern workman to throw over these ideals is to injure the only pride he has in work, and if he concedes his point it is but indulgently to humour what he considers an amiable weakness. It is usually only the younger workmen who are capable of understanding and realising the greater possibilities which are revealed in building when once the ideal of regularity for its own sake is given up. But any real reform can only be gained by a more intelligent teaching of building construction, and a recognition of the possibilities of ordinary craftsmanship. If one refers to any of the ordinary text-books placed before the student, the crafts are displayed with a stupid disregard to anything more than dull material considerations. A certain formula is given for the construction of a floor: joists of a certain regular size are to be placed a certain number of inches apart. Below them the plaster ceiling is fixed, and above them the boards. That is the way, and apparently the only way, to make floors. But if we visit an old house we shall find these joists placed with a fine disregard for exact spacing or equality of size. We shall note how the slight undulation of their outlines expresses the character of timber and suggests the lines of the grain. The plaster is fixed between these joists, which are left visible and are themselves supported by beams, which are again in their form, surface and outline, full of suggestion of the character of the material, so that they convey to us a hint of the fact that though now subdued to the will of man these beams had once been living trees of the forest. It is also always assumed, in these text-books, that the simplest way of doing a piece of work is the worst, and that really high-class work is distinguished by unnecessary elaboration. The general idea to be gathered from the building text-books is that we have, first, the rather plain and dull business of common building, which, as it develops in elaboration and ornateness, ascends in the scale till at last it becomes sufficiently complicated to be called architecture. It is on such principles as these that our architects and builders are trained; so that to learn anything about the art of building it is necessary for most of us to begin by forgetting everything we have been taught, and to pick up, as we can, mostly from old work, the general principles of the right kind of building.

The influence of machinery on the handicraft of building no doubt largely accounts for the

* All the houses illustrated are designed by the author.

mechanical ideals of the modern craftsman, although it would seem it ought to have the opposite result. For the craftsman should say, "Here am I engaged on a mechanical task. It might be easier to lay these bricks by machinery; but since they are to be arranged by a human being, would it not be well for me to put something into the work which no machine can compass?" Machinery, then, has its uses in showing us the futility of mechanical art, and emphasizes the importance of the direct, personal touch of the artist. It is well that machinery should be used in the service of man for executing those tasks which are outside the proper scope of handicraft. But in all machinery there seems to lurk a malignant imp, which imposes its will on us, narrowing our whole conception of the universe to a mechanical standard, and making us in the end the slaves of the monster we have created. On this subject of mechanical art, the eloquent words of John Ruskin may be quoted. He says: "It does not become our immortality to take an ease inconsistent with its authority, nor to suffer any instruments with which it can dispense to come between it and the things it rules; and he who would form the creations of his own mind by any other instrument than his own hand would also, if he might, give grinding organs to Heaven's angels to make their music easier. There is dreaming enough and earthiness enough and sensuality enough in human existence, without our turning the few glowing moments of it into mechanism; and since our life must at the best be but a vapour that appears for a little time and then vanishes away, let it at least appear as a cloud in the height of Heaven, not as the thick darkness that broods over the blast of the furnace and rolling of the wheel."

Fig. 15.—"The Cloisters," Avenue Road, N.W. (View from Road.)

One of the main differences between modern building and that of the past is its marked incoherence. As such it faithfully reflects the unrest of modern life. In the living ages of art in building, we may compare its life force to the chlorophyl which colours the leaves of

the trees. This chlorophyl has now become degraded, as a botanist would say, and individuality runs riot. The broad stream of modern building is of that peculiarly repugnant commercial kind which thinks to use art as a kind of bait. Instead of the confessed brutality of Victorian building, we have the picturesque villa, with its long, sloping roofs and other travesties of the features of the old English cottages. And it would appear that these things are gratefully accepted by an unsuspecting public. The house is given a ridiculous name, and filled with artistic furnishings, and no one seems to suspect there is anything wrong with it. Picturesqueness in the old village is right, because it is the natural outcome of requirements, and has not been deliberately aimed at for its own sake. It hardly appears to have been "designed," but to have merely inevitably occurred. And if we consider the quality of the building in the modern garden suburb, we shall find all the subtleties of the traditional craftsmanship of the past have disappeared in the modern work, and the cottages are run up by the help of labour which has lost all power of self-expression. Much, of course, must depend on design; but workmanship is vital. The man who shapes the timbers and lays the bricks supplies, at first hand, his contribution to the final appeal of the building, and can make or mar it. We should find no difficulty in recognising such an obvious contention as this in any art properly accredited as such. We know that each stroke of the painter's brush, and each touch of the musician's hand, goes to build up the final beauty of a picture or a sonata; but because we have forgotten that building is an art we have come to think of its processes as merely mechanical. In the meantime our architectural students are not interested in building at all. You will find them engrossed in the ancient architecture of Greece and Rome, and making ambitious schemes for royal palaces and public memorials. Not long ago there appeared in the architectural papers the students' designs submitted in a competitive exercise of their skill. And what was the subject? Was it a cottage or country house? Perish the thought that they should concern themselves with such trivialities! No, these beginners must begin at the top. They were to design a monument to commemorate the bringing of water to a town. This design was quite seriously undertaken, and resulted in variations on that particular kind of fatuity which consists of innumerable flights of steps leading nowhere in particular and culminating in a central sculptured imbecility which not even all the facilities provided in the way of steps would induce one to approach. I do not wish to reflect in any way on the ability shown by the students in these designs: I would merely wish that it were better directed in solving the practical problems of the day.

The difficulties in the way of the practice of the art of building in these days, due to the mechanical training of the architect, ruling his lines on a board, and the bricklayer, ruling his lines on the wall, are only a part of the artificial obstacles put in the way of the artist in building. He has in most districts to face also an arbitrary, vexatious and irrational set of rules, and to fit his building to the Procrustean bed of the building by-laws. I cannot now enter into a detailed exposure of the illogical absurdity of these enactments. They interfere either too little or too much with the liberty of the subject. They set forth cast-iron regulations for the height and window areas of bedrooms, for example, but they cannot prevent the windows being covered with curtains, as they generally are, and they cannot prevent the householder sleeping in a cupboard under the stair, or in the coal cellar if he has a mind. If we are to be dragooned into healthy ways of living, it should be done consistently or not at all, for the application of the building by-laws in many cases defeats the end in view. For instance, in attic rooms it is usually enacted there must be at least 5 ft. height at the sides. The application of this rule to the ordinary attic means a reduction in the cubic capacity of the room.

I think, if I were asked what is the most satisfactory feature in modern house building, I should say it was the scaffolding. In constructing it we find there is a recognised tradition, and a rough-and-ready simplicity and honest adaptation of means to ends — all the qualities in short which, in the modern building it surrounds, are so conspicuously absent. It evidences the fact that the pursuit of beauty in building is so often almost as vain as the pursuit of happiness in life. Both alike are by-products, and arrive as a reward for doing the right thing in a simple straightforward way. As an example of the qualities of scaffolding, I may mention the forest of spars and knotted rope which just now encloses the Albert Memorial; and in passing it to-day I was led to hope that the work which is being done there may not be completed too soon.

Since I began this course of lectures on house

building, the inadequacy of my treatment of the subject has been brought home to me by various communications I have received with reference to several practical aspects of the question. With regard to many of the latest inventions in the practical appointments of the modern house, I share the common English quality of requiring that some one else shall be the first to experiment with them. I can at least say that I am a believer in the use of gas for cookery—if not entirely, at least as a supplement to the kitchen range; and, for the latter, the use of anthracite as a fuel has many great advantages. In these adjuncts of the house, however, I can never understand why it is necessary to make such things as kitchen ranges and stoves and radiators so unnecessarily ugly, and why we should not have in them some of the simplicity and beauty of design in casting which we find in the old Sussex cast-iron work, for instance. I believe the only well-designed kitchen range I have seen, from this point of view, is, alas, made in Germany. Hitherto, I have dwelt at some length on the vital importance of workmanship to house building, because that seems to me to have been most neglected and misunderstood. I now propose to say a few words on a subject equally vital.

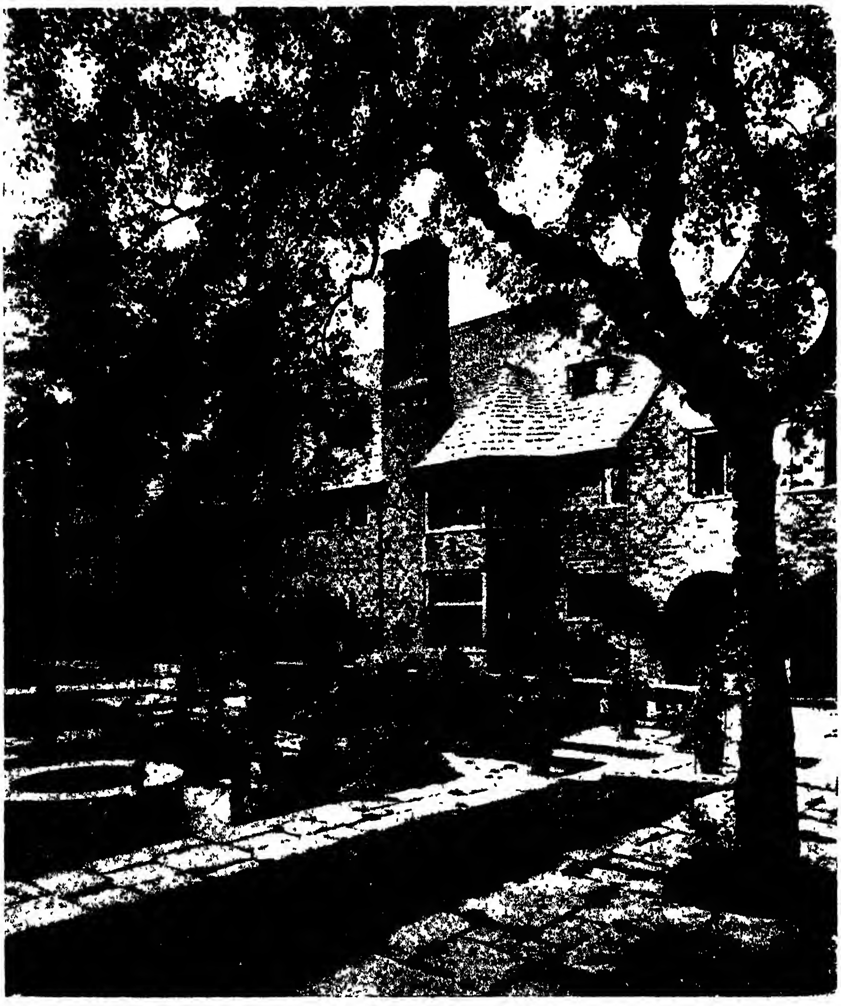

FIG. 16.—"THE CLOISTERS." (The Garden Front.)

The importance of proportion in the design of houses can hardly be overestimated. It is the fundamental thing. It is all the more unfortunate, then, that it eludes definition and explanation. It is a mystery and must remain so. In speaking of proportion as applied to the house, I mean by it not only the shapes

of its masses and the dimensions of its apartments, but also the relative sizes of all the parts of its structure. Used in this sense, proportion is often described as "scale," and a certain feature in a building is said to be "out of scale" when it is disproportionate. Not only in building, but in all the affairs of life a proper sense of proportion is of great value. To discern the proper significance of facts in relation to other facts without distortion is the mark of a well-balanced mind. The man who is obsessed with some idea which obscures his vision of the real facts of life is condemned as a faddist and a crank. Translated into terms of building, such an attitude would be represented by a house which is all bay window and staircase. And how disproportionate are the views of so many on the question of house building! One is all for the artistic, for quaintness and picturesqueness, without proper recognition of practical functions. Another is all for sanitation. He would have no corners to his rooms, no foothold anywhere for dust; one might imagine he would protest almost against the existence of houses at all, so that there would be no place for dirt and dust to collect. Then there is the light and air specialist, and the logical outcome of his attitude would make each house a little Crystal Palace. Or again, the labour-saving crank, whose ideal state would involve complete bodily inactivity, so that instead of performing the ordinary work of life one would be driven for health's sake to resort to some kind of physical drill to replace the healthful activity we have relegated to the machine. In such a welter of conflicting and disproportionate ideals we must try to hold a proper balance, and to look at things broadly and sanely; and the best houses I know are those which bear the stamp of a kind of inspired common sense, and contrive to weld into one the beauty of the old house and the practical contributions which modern science has made to domestic life. Without suggesting any mechanical rules of proportion, it may be at least safely affirmed that masses of structure which are long and low and broad-based convey the idea of calm and tolerant breadth of mind and wise humility, while buildings which soar high on narrow bases suggest ambition and aspiration. Each has the defects proper to its qualities, and as the broad-minded philosopher is apt to miss the significance of the higher flights of the soul of man, so the aspiring devotee may be narrow in his judgments. But, apart from such generalities, the general principles of proportion are to be felt rather than reasoned about, and a sense of proportion is to be gained by a study of good examples in the past, where the instinct for such matters was so unerringly fostered by tradition.

It must always be remembered that art in the past was not the highly specialised matter that it is to-day, and was concerned with practically all the activities of man. In modern practice, the painter recognises the value of relative proportion in the various parts of his picture, and he knows how the qualities of each colour and tone are modified by other colours and tones; but this sense of relative proportion with him stops short of the picture frame, which effectually cuts off the picture from the outside world, in the same way that the artist himself in the modern world is disassociated from the general field of human activity. But when building was the mistress art, and all other arts combined with the single idea of producing beautiful buildings, when the house was not merely a shelter for art treasures but itself the art treasure, then the same sense of relative proportion, now practised in the confines of the picture frame, spread itself over the world, and so the house was in harmony with nature and with other houses, and the furniture and ornaments were duly related to the house. How strange in such a world would have appeared the modern picture gallery, or the modern museum, in which art now takes refuge from life! In the picture gallery the walls are not adorned by decorative painting, but covered with isolated competing individualities; and in the museum all the ordinary appliances of life in the past are found divorced from their place and function and condemned to idleness, like able-bodied paupers on a bench in the workhouse of the arts. In the past all this painting and all these art treasures found their places as the normal setting of life in the houses of the people. There was no need for the picture gallery or the museum, for the whole world was a museum in which all the appliances of domestic life were both serviceable and beautiful.

In giving practical illustrations of the general principles of proportion in building, it will be well to consider first the design of the cottage. Here the building is necessarily a small one, and all its features must be small too, and the whole conception reduced in scale; and if this is done consistently and completely, in spite of smallness there will be no sense of disproportion. If, however, a window is made too large in scale, or the staircase developed as an artistic feature, or if a desire for a lofty ceiling

is allowed to obtrude, the whole modest balance of the building is upset, and the cottage becomes an abortive villa. And in the larger houses a like proportion is necessary, and the smallness of parts so desirable in the cottage often becomes pettiness when applied to larger houses, and in all no single feature stands by itself on its own individual merits, but can only be judged in relation to the whole building.

FIG. 17.—"THE CLOISTERS." (The Hall.)

As a starting-point in designing the modern house, we have all the work of the past to guide our choice, which, broadly, will lie between two types of what may be called the "craftsman," or romantic house, and the "scholar," or classic house; the house built on Gothic principles and the house built on Renaissance principles. The main difference between the two is that the Gothic work makes the constructive features of the house itself the elements of its appeal: it is a piece of building art to which any other decorative arts that may be introduced are subordinate. The beams of the ceilings are visible and the framing of partitions. We can read everywhere the story of the structure which gains a kind of individuality and reality. But in the Renaissance building, beauty is only skin deep; structure is everywhere concealed by superficial casings, walls and ceilings are coated with plaster, and all the structural features of the house hidden, while the interest of the rooms is centred on fabrics, pictures and ornaments. The main interest is transferred from the house itself to its accessories, and the house tends to become a convenient sort of box for sheltering people and their belongings—a box which may have

its external adornments and trimmings, but which no longer relies on the realities of structure for its significance as an essay in the builder's art. The main quality of the craftsman building is that it is elastic and accommodating. Windows and doors can be placed where they are wanted and the whole effect is natural, unaffected and homely. It kindles the imagination, and is full of the mysterious charm of romance. The classic house represents a statement complete and finite. It is a conscious piece of art which has been definitely arranged from the outside - not the natural outcome of internal requirements. It seems to challenge our regard and demand our homage. There is no escape from the insistence of its façades. But the craftsman house is more subtle in its appeal. It is casual; it rambles and dissembles; and only when we have entered the wide, low doorway, and become steeped in the deep and silent influences which breathe from its walls, do we begin to realise the potency of its charm. I must confess to a preference for this earlier building art; but it must be admitted that the classic house, on grounds of expediency, has much to recommend it in these days. Relying as it does more on design than on craftsmanship, it does not suffer much from machine-made mouldings and mechanical workmanship. Its parts might be standardised and made in a factory. Divided as it is into rectangular plastered boxes, it is easier to build under modern conditions, and it seems to express very well the kind of occupant whose ideals consist in a strict observance of the routine of life. If you can appreciate the mystery and magic of the earlier houses, and if you can feel the unfathomable depth and the warmth of their appeal, I doubt whether you will be quite satisfied with the Renaissance house, although its dignity and reticence is something to be thankful for. It is scholarly correct, and in good taste, but somewhat trite and shallow. It may be urged, however, that, as a starting-point for the modern house, we need not limit ourselves to the two types of old English house I have mentioned—the Gothic and classic. There are certainly the houses of other countries to be considered, although most of these can, in their principles, be referred to the two types I have mentioned. Of these, the Dutch houses have already been to some extent naturalised in the eastern counties of England; the Italian villa, as seen through Victorian spectacles, has hardly proved a successful model for the English house. The Swiss houses, delightful as they are in their own country, would only be suitable for ours if we could import the Alps as well. All these and many other ancient types of houses may be studied and inwardly digested, but not imitated. And then again we may fling away the past altogether, and devise the modern house as an expression of modern needs without any reference to the work of our fathers and other people's fathers. This scheme seems to open out a fascinating prospect. But building is such an old art that it is obviously foolish to cast aside all the garnered experience of the past. Let us hold fast all that has been well done, whatever bad work we may reject. Instead of cleaning the slate let us leave on it all the sums that have been worked out right. Originality in design and novelty of form are not essential. The novelty of to-day is the monstrosity of to-morrow. A review of the houses of the past will show that it is not the cleverness of their designs nor the novelty and originality of their work which delights us. These qualities are more apt to constitute a weakness. Soundness and common-sense are more valuable qualities in building than cleverness. When all is said, it seems to me the best kind of house is that which possesses that depth and earnestness of appeal which belonged to the old houses of the craftsman period, and in which the mystery and magic of romance seemed the outcome of work done in simple, honest and straightforward ways. One of the most depressing qualities of modern building is the deadly soul-destroying stupidity of it all—the waste of human faculty in trying to achieve mechanical regularity, as if man with all his powers could find nothing better to emulate than the work of a machine. And so one of the most cheering features in the old craftsman work is the intelligence it displays in this respect.

I know there are those who may appreciate more the work of the scholar period with its symmetrical façades, its superficial refinements, and its coldly correct and severe apartments. Or, again, there are others who regard the whole application of artistic ideals to the house as something of a nuisance, who would have the artist keep within his proper field as a painter of pictures, and who look upon the house as a purely utilitarian affair, a kind of glorified pig's trough where meals may be conveniently eaten.

Such varied ideals must be the outcome of various minds, and I can only speak of my own dream of the house. Mere conveniences,

much as I appreciate them, would not fulfil my demands, and the strict and bounded formality of scholarly architecture leaves me cold and dissatisfied. Give me rather the house of romance. I would have as its main apartment a hall or houseplace of ample floor space, broad and low. Great oak beams should span it. and great oak boards compose its floor. At one end, a deep and wide ingle with one of those open chimneys, in which one can see the blue smoke from the wood fire swirling kind which used to be made by the old English craftsman. The house should, indeed, breathe out those happy influences which go with this home-made kind of work, without a hint of the glib and shallow dexterities of the factory or the products of modern trade art. And, above all, I would have nothing too fine or dainty for its uses, and should refuse to be intimidated by the silent tyranny of artistic furnishings. This hall must be of such a homely kind that my dog may enter there without rebuke. It must not

Fig. 18.—"The Cloisters." (The Dining Room.)

upwards, would please me better than any narrow modern grate with its petty art tiles and mantel. On the wide hearth the proper appointments of the fireside would twinkle and gleam in the firelight. And on the walls I would have no machine-made picture rails, no friezes or any paperhanger's art, only innocent spaces of white, varied perhaps with a tapestry hanging on such solid timbers as the structure of the house requires. There would be a few rugs on the oak floor, and the few furnishings would be of the easy home-made merely look like a piece of a cabinet-maker's shop window nor represent a correct reproduction of any period. Nor must it appear as a museum, with its walls and floor space crowded with a jackdaw hoard of art treasures. There should be no more furniture there than the uses of the room demand, and the quality I should most appreciate would be restfulness and quiet simplicity.

Having secured this central apartment, which would almost constitute the house, the further development of the plan would depend on

the resources at my disposal. Opening from the wide spaces of the hall would be a little "growlery" or study, like a little chapel attached to the nave of an old church, and this might well be lined with books. Its smallness would give it a distinctly intimate quality, and would never appear cramped owing to its immediate connection with the roomy hall. Opening off The woodwork here would be painted green, and the general effect would have the fresh cleanly aspect of the Dutch kitchen. I should not consider it essential to make a great feature of the staircase, and in small houses there is much to be said for the old cottage type of stairs which open from the hall by a door which appears to be a cupboard. The bedrooms

Fig. 19.—"The Cloisters." (The Sitting Room.)

the hall again would be the dining-room, and this I should like to have panelled in oak. Beyond the dining-room, the serving pantry would communicate with it by a door which would disappear as a door, and become mere panelling when shut. The kitchen premises, compactly and serviceably arranged, should as far as possible be lined with white tiles, not of the usual harsh, glaring, modern quality, but with the friendly twinkle of the Dutch tiles. would be broad and low in their proportions with long low casement windows; and, arranging the bath-room close to a dressing-room, it would be well to have an extra bath in the latter.

The conception of the house, considered from the artistic point of view, will in no way militate against more practical considerations. The absence of unnecessary furnishings will make it easy to clean, and the saving of all unnecessary labour will be to a great extent the reward of

FIG. 20.—"THE CLOISTERS." (A Dressing Room.)

a proper regard to an ideal of simplicity. I do not propose to have a white marble threshold at the entrance with a spray of water specially laid on to clean it, as Mr. Arnold Bennett has ingeniously proposed. My threshold will be of oak. Nor do I intend to round off all the corners of the rooms. But I should have, as far as possible, fixed basins in the bedrooms with hot and cold water laid on, and, above all, if funds would permit, a proper installation of a vacuum cleaning plant, so that the usual method of chasing dust from place to place in the house should be replaced by a scheme for drawing it down to a receptacle in the basement. In the house I am considering it will hardly be possible to rely entirely on the fires to warm it completely, especially in the case of the hall or houseplace, where the great open hearth and chimney is deliberately chosen in favour of the modern grate. I do not, however, wish you too hastily to dismiss the old open fire as entirely unscientific. The great mass of brickwork in which these old fireplaces were formed, centrally situated in the house, actually forms a storehouse of heat which is retained by the brickwork—for brick has the quality of absorbing and holding and gradually radiating heat, so that in baking bread in an old-fashioned brick oven, for instance, the fire is extinguished before the oven is used. And this storage of central heat in the house provides a continual supply of warmth to the adjoining rooms. If, in addition to this, a modern system of central heating is introduced, in cold weather it will be possible to use every part of the rooms, and the fire itself will mainly attract us for its beauty. To remove the open fire altogether, as in Continental houses, is from a scientific point of view quite reasonable. But I doubt whether there is anyone who is not notably warmed in spirit as well as in body by the sight of a fire on a cheerless day. A room without a fire is like a landscape without the sun. Even when cramped in the narrow confines of a modern grate, the fire asserts its charm. But when it has its ancient setting of the great open hearth, when it is composed of logs and snapping twigs, and the light of it gleams on copper and brass, it creates for us a picture we cannot well do without. It seems to be the warm heart of the

house and the symbol of its hospitalities, and few scents are more welcome than the aromatic incense of the burning wood.

In this rough sketch of an ideal house, it will be noted I have been mainly concerned with the interior, partly because it seems to me most important, and also because I believe, if the general proportions of the rooms are good, the world of Nature, and this harmony can only be achieved by proportion and workmanship of the right kind, and by that kind of design, which can hardly be called design at all, which is the resultant of internal requirements. A somewhat casual, rambling and unconscious air, as of a building which has grown out of the ground and is the outcome of local conditions, seems better than

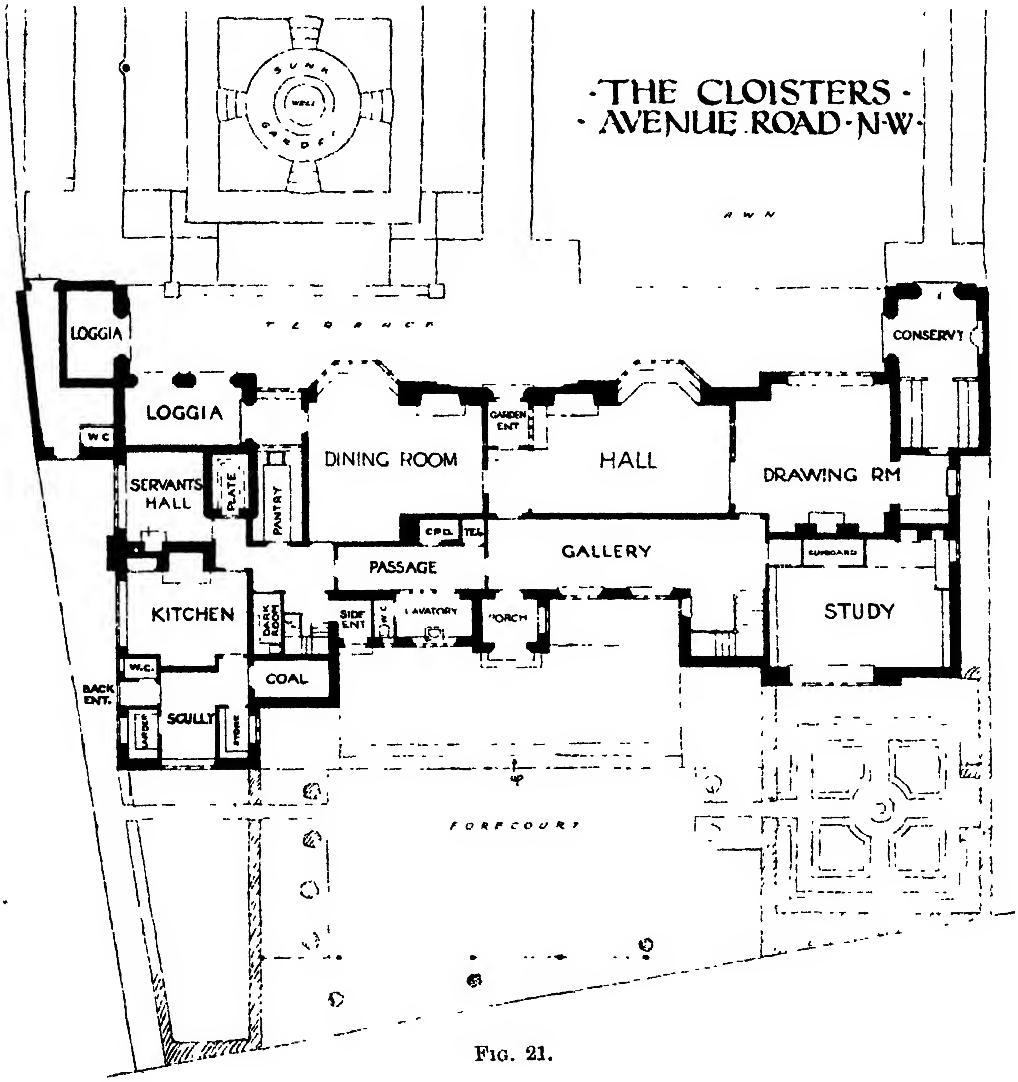

Fig. 21.

proportions of the exterior will be no less satisfactory. Houses, I think, should be designed from within outwards. And then I always prefer the kind of house which dissembles a little in its outward aspect. An imposing façade is somewhat of a bore. It seems to stare one out of countenance. For a country house especially, the best that can be said for the exterior is that it is in harmony with the some imported preconception in the latest architectural fashion of the day. And in the general tone and colouring of the building, in most cases, the natural principle of protective tints may be wisely adopted, so that the house seems almost to become a piece of Nature.

The kind of garden which should surround the house I can only briefly refer to here. I would have no vague and shapeless shrubberies

or curly paths and sinuous carriage-drive. The garden would be an outdoor extension of the house, and consist of green-walled apartments linked together to form vista lines. The paths should, as far as possible, be paved with stone or brick, and these in many cases set in mown grass, or bordered with spreading flowers which would invade their boundaries. There should be no hard clipped grass edges: the same fatal spirit of mechanical regularity which has been banished from the house should find no place in the garden. Flowers should be set in masses and drifts of colour, and not dotted at regular intervals in the borders. The horrid trinity of calceolaria, geranium, and lobelia should edge no paths of mine. It should be a garden somewhat formal and yet not without a casual air, with massed profusion of flowers relieved against dark backgrounds— a garden of sunshine and shade, with open spaces of mown grass and many roses, carnations, lilies, and other old-fashioned flowers. It should not reveal at once all its beauties. And, if possible, there should be added the pleasant chatter of running water, as well as the stillness of deep pools.

In revising these rambling remarks of mine on house building, I am painfully conscious that I have done but scant justice to my subject. The soul of the house is an elusive thing. It can hardly be described in words, and only faintly indicated in pictures or photographs. Only in the actual buildings themselves do we experience the impact of their personalities. And how varied these are! In the old craftsman houses, especially when they are unoccupied and free from modern trappings, one is aware of all kinds of deep influences and unspoken messages breathed forth from the walls. One seems to be brought into touch with those long-departed builders, and to realise here in their work the depth and earnestness of their endeavour. Something of their inmost life has been projected through the ages, and has taken definite shape in the work of their hands; and, as we pass from room to room, we find ourselves soothed and charmed and enveloped in an atmosphere of peace. The whole building seems to hold the secret of some exquisite enchantment, and active occupation for the mind does not seem necessary there, for the building itself is a continual feast. In the average modern house, with its harsh repellent personality, we must always be doing something to escape from its influence. We can only bear to live in it by continually looking out of the window at the "view." It is impossible to escape from the inherent meanness and sordidness of its nature, disguise it as we will with elaborate furnishings, and, when empty of them, it stands revealed in its true character: it is desolate indeed.

Building is not recognised at all as an art in the modern world, where the popular conception of art is of something which is framed and glazed and put in a public gallery; and until we begin to learn that art is something more than that, we cannot hope to have any good building again, or anything better than what Professor Lethaby has aptly called "architect's architecture" for the few, and what I may call "builder's building" for the many.

HINDU PIECE-GOODS TICKETS.

According to the *Pioneer Mail*, the Marwari Chamber of Commerce in Calcutta have recently applied to the Bengal Chamber of Commerce to use its influence to "abolish the use of pictorial representations of Hindu gods and goddesses as designs for stamps, tickets, and labels on boxes, packages, and pieces of various kinds of goods and articles of merchandise," and so on. It would be interesting to discover the genesis of the request. These tickets of "gods and goddesses," their incarnations, their satellites, and of incidents of Hindu mythology, were all introduced by the bania dealers, a large proportion of whom, all over up-country and in Calcutta, are Marwaris. All these pictures of Krishna and Bhairo and Devi and Kali, it is true, are printed in Manchester, but they were prepared from hand-paintings by Hindu Massawars and sent home through importing houses by the wholesale dealers of buyers of cloth. In the up-country markets and in Calcutta there is probably not a single Mohammedan wholesale importer (known as a "dealer") of cotton piece-goods; these dealers are all Hindus. It is the Hindu dealer who has himself selected practically every Hindu "god" ticket now appearing on every quality of cotton piece-goods imported into India. The Marwari Chamber "notices with regret" that the practice "necessarily leads to pictures of the gods and goddesses whose images form the subjects of worship in Hindu homes and temples being thrown away in the street, trampled under foot, etc., etc., which cannot but hurt the religious feelings of the Hindus." The average Manchester or Glasgow piece-goods' expert certainly cannot distinguish one god of the Hindu pantheon from another, and the responsibility for selecting Hindu tickets is on the Marwari dealer. The suggestion that the use of Hindu gods' and goddesses' tickets has been at the instigation of or encouraged in any way by European houses is preposterous, and is so absurdly ingenuous that it certainly merits further investigation. Does the Marwari pretend he is suddenly going to give up tickets, the abandonment of which

means further losses in an already depreciated piece-goods market, and an extraordinary dislocation of trade? There are thousands of cases—*i.e.*, packages and bales—which mean millions of yards of certain Manchester goods, which sell in every village bazaar in Northern India, to take one concrete instance, under the name of a certain popular Hindu deity. This is a proprietary mark which has been imported for twenty or thirty years past. Many Indian dealers import this one mark and nothing else. The villager refuses to buy or accept any other mark. How are the dozens of established Hindu deity marks to be substituted? There are hundreds of similar instances—white shirtings, mulls, dhotics, red and dyed goods, prints, all with well-known marks or tickets (or "chops" as they are called further East), all with representations of Hindu gods and goddesses. Practically every bania's shop in India has hundreds of these "piece-goods" tickets pasted on the back of his shop walls, doors, windows, etc. They are beautiful pictures to him of his particular deities or incarnations thereof, and he appreciates them. A dislocation of established marks and tickets on piece-goods at the present juncture is most undesirable. The piece-goods market is bad enough as it is—there are other competitors in the field, and when the war is over it will probably be difficult enough for piece-goods importers to hold their own against "other and certain" new competitors. But to prepare the way for this outside anticipated competition by breaking up established and proprietary marks just at the very moment when we all would like to see them established firmer than ever, would be a policy of suicide which one does not ordinarily associate with the outlook of the Marwari. The whole matter is far more serious than it may appear to the casual observer and to the ordinary official up-country, but it merits notice as it affects one of the most important trades of the country. It should be realised that on an average about 40 per cent. of the total of imports into India consists of cotton piece-goods.

ENGINEERING NOTES.

The Longest Simple Truss Span in the World.—Silicon-steel main members and nickel steel eye-bars have been adopted for the main truss spans of the new bridge to be constructed over the Ohio River at Metropolitis, Illinois. This structure will contain the longest simple truss span in the world—about 720 ft. centre to centre of the end pins. The total length of the steelwork will be more than one mile, and the total cost is estimated at about £700,000. The bridge is to be a double-track structure, designed for unusually heavy live loading. The total length of the steelwork in the new structure will be about 5,487 ft., consisting of six through-spans and one deck-truss span, and a viaduct approach on each side, in which fifteen 80-ft. towers, supporting girders of various lengths from 62 ft. to 90 ft. 6 in., will be used. The floor of these approaches will be of the solid ballasted type, constructed on 0·2 and 0·3 per cent. grades, while the main truss floors are of the usual open deck construction. The underclearance required above high water is 53 ft., with 700 ft. maximum clear opening. All the trusses, except those in the shorter spans at each end, are of the through curved-chord pin-connected type, with sub-panels throughout, using sub-diagonals in compression. The piers are being constructed by the use of pneumatic caissons, which vary in size from 47 ft. by 80 ft. to 60 ft. by 110 ft. The fixed and expansion ends alternate, the Illinois end of each span being fixed. Piles are used under the concrete piers on the approaches.

Water Power in Norway.—The exploitation of the Saude Falls, according to the *Times*, is now to be taken in hand. From the Storli River a tunnel, 600 metres in length will be blasted in the rock, and the height of fall available will be no less than 280 metres. The power station here, the first of a series, will have a capacity of 27,000 h.p. By damming the level of the Storli, water will be raised 12 metres, and that of the Dalwater 20 metres. The level of several other lakes, or waters as they are generally called, will be raised by means of dams. The next station will be placed at the Dalwater, and will have a capacity of 10,000 to 12,000 h.p.; somewhat lower, a third station, the largest of them all, with a calculated capacity of 40,000 to 45,000 h.p., will be established; and the fourth, and last, of 10,000 to 12,000 h.p., will be constructed at Slettedal. The aggregate power obtained from the exploitation of this cluster of falls will amount to 100,000 h.p., and 40,000 h.p. have already been disposed of to the Electric Furnace Products Co., which may want an additional like quantity. The delivery is to be by degrees, the first 20,000 h.p. being available at the beginning of 1918. The first phase of construction, 40,000 h.p., is calculated to entail an expenditure of from £350,000 to £400,000; the next, 40,000 h.p., will be somewhat more expensive. While the work at the Saude Falls is only just being started, an important section of another kindred, and still larger, undertaking, has been completed, viz., the huge dam of the Vamma hydro-electric power station, which forms a reservoir holding 20,000,000 cubic metres. It has been built for the purpose of raising the level of the Glommen, and thereby increasing the height of the fall. When the installation is complete, there will be some 180,000 h.p. available. The portion of the power station now built is to contain six units, of which two, each of 12,000 h.p., are being installed.

The Leon Torpedo.—In a recent issue of *Le Génie Civil* the sinking of the warships "Bouvet," "Irresistible," and "Ocean" in the Dardanelles is attributed to the Leon torpedo. This weapon was invented in 1907 by a Swedish officer, Captain Carl Leon, and combines the characteristics of the

submarine mine and the self-propelled torpedo. Its activities consist in drifting with the tide and predetermined vertical movements produced by its own motive power. For instance, the torpedo may be required to drift about at a certain depth. The pressure of the water, varying according to the depth, actuates a sensitive hydrostat, which closes or opens a switch connecting a battery with an electric motor, which drives a vertical propeller, keeping the torpedo within a certain depth. For sinking ships in an enemy harbour, these torpedoes may be sent to drift in with the ingoing tide, a clock mechanism bringing the motive power into operation at the turn of the tide, making the torpedoes sink and rise again at the ebb. As originally constructed, the motive power was provided by compressed air which, suitably controlled by a hydrostat, allowed the air to be admitted to, or escape from, a flotation chamber, which thus governed the buoyancy and maintained the torpedo at the predetermined level. As now constructed, however, the movements are produced by a vertical propeller and electric motor located at the lower end of the torpedo body. The battery is contained in a central compartment, while the explosive and firing apparatus is placed in the upper end, the weights as a whole being arranged so that when submerged the machine takes up a vertical position. A "stabilising" mechanism is also provided, whereby the buoyancy of the torpedo can be adjusted to suit the density of the water.

Special Steel for Rails.—Mr. W. C. Cushing, permanent way engineer of the Pennsylvania railways, in the July *Bulletin* of the American Railway Engineering Association, summarises his views as follows: (1) Cast manganese steel has been proved by long experience, under exacting conditions, to be a satisfactory and safe metal for the manufacture of points and crossings. (2) The trials of rolled manganese steel for rails and for the manufacture of points and crossings have not been so extensive as with the cast product, but have been continued to a sufficient degree to enable us to conclude that it will be ultimately suitable for these uses at locations where great strength, toughness and a maximum abrasive resistance are desirable. (3) The experiments with nickel, and nickel and chromium in certain proportions, in rail steel have not, up to the present time, been entirely satisfactory; but the accepted employment of nickel steel in bridge construction, and the trials of nickel and chromium in other proportions in rail steel, especially when incorporated as two of the natural elements of the iron ore, justify continued use. (4) The use of high carbon (over 80 per cent.) in rails weighing 85 lb. per yard, in combination with ·92 to 1·00 per cent. of nickel, and ·24 to ·29 per cent. of chromium, has not been satisfactory. The conditions with rail sections of greater weight might be entirely different. (5) Further study of the qualities possessed by high silicon rails, that is, steel with over ·3 per cent. of silicon, is advisable. (6) The value of the use of ferro-titanium in rail steel manufacture as a "physic" for improving the condition of solidity of the metal is conceded, but at the same time steps should be taken to overcome its injurious effect in deepening the "pipe" in the ingot. (7) Heat-treated rails, and those manufactured with the assistance of the electric process, are at present in experimental use only, but the possibility of future value is promising, and the study should be continued. Mr. Cushing's paper was to have been presented at the International Railway Congress in Berlin, but was transferred to the above association owing to the war.

The Coming of the Motor Plough.—Of all the work which has to be done on farms, ploughing is perhaps the most extravagant in power and the most dependent upon the conditions of the land and weather. On large estates the cable system of steam ploughing has been brought to a high state of perfection. Not many farmers, however, can afford a set of steam-ploughing tackle, nor are there many farms in these islands of such a size as would make its employment a paying proposition. As the *Engineer* points out, what is greatly wanted is a motor tractor neither too costly nor too complicated—that can be put to some practical use at all seasons of the year, and it would appear that such a machine is now in course of evolution. Apart from the cable-haulage system of ploughing already mentioned, the systems of motor ploughing are chiefly divided into two classes, namely, those in which the motive mechanism and the plough are two separate units and those in which the two are combined. For all-round usefulness the separate haulage system possesses important advantages, as motive mechanism can be readily attached to various kinds of implements. The disadvantages urged against the separate tractor are several. One is the necessity for employing two men—one on the tractor and one on the plough. With regard to the type of motor to be used, the steam-engine has not yet been adapted to the self-contained machine, owing to the weight of the water and fuel which it has to carry. So far the petrol engine has monopolised the field, and with spirit at a moderate price such engines will continue in favour, though developments may be expected in connection with paraffin engines. As regards the amount of power required, current practice would seem to show that with engines of 20 to 25 h.p. satisfactory work can be done on average land with ploughs of two and even three furrows and taking cuts 7 in. deep. With this amount of power it is possible to plough from three to six acres in a day of nine hours. In order to relieve the land from excessive pressure and give a more direct pull when engaged in pulling the plough, some tractors are designed to run with one driving wheel in the furrow. This method has also the advantage of keeping the furrows parallel and making steering easy. As several of the

leading manufacturers of motor ploughs have adopted this idea it would seem that the system is based on sound principles. The petrol consumed by a motor plough is said to be about two gallons per acre of land ploughed and its capacity three acres per day of nine hours.

OBITUARY.

SIR ROBERT LAIDLAW.—Sir Robert Laidlaw died on the 3rd inst. at his residence, Warren House, Hayes, Kent. He was born at Bonchester, Roxburghshire, in 1856. Going out to India, he founded the well-known firm of Whiteaway, Laidlaw & Co., of which he was chairman, as well as of the Dusun Durian Rubber Estate, Limited. He was also largely interested in other enterprises in the East: he owned tea estates in Darjeeling, and had considerable holdings in rubber estates in the Federated Malay States and Java. In 1909 he was the British representative at the International Opium Commission at Shanghai, and in recognition of his services there he was created a knight.

From 1906 to 1910 he sat as Liberal M.P. for East Renfrewshire, and four years ago he was adopted as prospective Liberal candidate for his native county, Roxburghshire. He was keenly interested in Indian problems, especially those connected with education. He took a prominent part in the recent movement to provide educational facilities for poor children of British descent in India, for which £100,000 was raised in this country. He also gave much time and energy to Y.M.C.A. and missionary work. He was treasurer of the London Missionary Society, and had been President of the World's Sunday School Union.

He was elected a member of the Royal Society of Arts in 1903.

GENERAL NOTES.

THE COAL-TAR DYE INDUSTRY.—The October number of *Science Progress* contains the first part of an article on "The Influence of Research on the Development of the Coal-Tar Dye Industry," by Dr. F. A. Mason. An interesting account is given of the origin of the industry in this country, and especially of the parts played by Perkin, Hofmann, and Caro. Dr. Mason makes it clear that the reason why the industry, although it was started, and for a time made considerable and promising progress in this country, subsequently became the monopoly of Germany, was the dearth of British students of organic chemistry. "Both by nature and good fortune," he writes, "England seemed to be destined to be the great coal-tar dye producing country of the world; Great Britain produced more tar than any other country, the first synthetic dye was discovered here, and Professor Hofmann himself, at the Royal College of Chemistry, was the centre of attraction of the industry, one thing only was lacking, namely, a sufficient scientific education of the general public, such as was already obtaining in Germany, and a sympathetic understanding and appreciation of the methods and objects of research. To this last is to be traced, directly and indirectly, the ultimate collapse of the British dye industry."

A MAHARANEE'S WAR JOURNAL.—A weekly journal has been started by Her Highness the Maharanee of Bhavnagar for the special purpose of encouraging recruiting in India, and giving the people there an accurate account of the operations week by week. German agencies had been very busy at first in propagating in India, as elsewhere, falsehoods about the causes of the war, and this journal, called "British and Hindi Vikram," in its first numbers successfully dispelled such misrepresentations. It has continued to chronicle the events of the war from official and authoritative sources, occasionally accompanied with illustrations, and has thus been the means of diffusing among the vast Gujarati population of India, who are not able to read English papers, accurate information regarding the achievements of British and Indian arms. It is, we believe, the first instance of journalistic enterprise on the part of an Indian princess, and a notable item in the scheme of loyal co-operation which her husband, the Maharaja of Bhavnagar, has been rendering in various ways to the paramount Power from the first day of the war.

COMMERCIAL MUSEUM IN CALCUTTA.—A press *communiqué* states that, in view of the success which attended the sample exhibition of goods imported from Germany and Austria-Hungary and of competing Indian manufacturers recently held at Calcutta and certain other commercial centres, the Government of India have decided to establish a permanent commercial museum in India. The museum will be located in Calcutta, and will be attached to and form part of the Department of Commercial Intelligence. The collection of samples and exhibits will naturally take time, and the development of the museum must necessarily be gradual. It is intended that the museum should contain samples of the principal manufactures imported into India from all foreign countries with which there is any existing or prospective Indian competition, and also representative samples of the corresponding Indian manufactures. It will also contain samples of goods marketed in foreign countries which India might be in a position to supply. It is further intended to exhibit representative samples of raw materials exported to foreign countries to be reimported which occur in India, but are not at present worked, although products manufactured from similar materials are imported in considerable quantities. The samples exhibited will be supplemented by catalogues and price lists, which will be kept continuously up-to-date by printed statistics, wherever possible,

showing the extent of the various markets in India and abroad, and by other information explanatory of the details of the trade names and addresses of firms dealing in the various trades will be maintained in the Commercial Intelligence Department, and will be available for the information of buyers and sellers.

CASCARA SAGRADA.—An account of the history, growth, methods of collection, and bibliography of the drug Cascara Sagrada (*Rhamnus Purshiana*) is contained in a recent issue of the *American Journal of Pharmacy*. The tree is stated to occur in the States of Washington, Oregon and Northern California, and in the Cascade mountains of British Columbia. It is said to prefer a light sandy soil, with a good rainfall, and grows at altitudes varying from sea-level to 2,000 ft. The tree grows fairly rapidly, reaching a height of 20 ft. to 30 ft. and a diameter of 6 in. to 8 in. in about ten years. Trees of over 4 in. diameter are felled, the bark stripped during the summer months and cured by a few days' exposure to sunlight. During the period 1902-1912 the annual average production is stated to have been about 600 tons.

PRESERVED MANGOES. — A new industry, the preservation of mangoes, has recently been started in Manila. Although the enterprise is at present on a small scale, it promises to develop to very considerable proportions. The Philippines is the home of the mango, and for years efforts have been made to prolong the use of the fruit and its excellent flavour, the season for the mango being comparatively short, and the delicate nature of the fruit preventing its retention for any length of time, or its export from the islands. It is stated that a satisfactory process of preserving the fruit in glass jars has been discovered. The preserved fruit is to be known as mango honey.

THE EXPORT OF CACAO FROM ECUADOR.—The yield of the cacao harvest in the Republic of Ecuador last year appears to have been below the average. The exports for the six months ending January 31st last, which amounted to 168,087 sacks, show a falling off of 132,625 sacks, as compared with those of the corresponding period of the previous year, which were 300,772 sacks. The average weight of the sack is 150 lb. net. The exports from Guayaquil, the chief port, represent about four-fifths of the entire crop, and about three-fifths of its total value. The exports to Italy, which in 1913 only amounted to 2,600 sacks, increased last year to 15,763 sacks, weighing 1,075,760 kilogrammes (2,372,050 lb.), to the value of 1,000,000 Italian lire (£44,000 sterling) f.o.b. Guayaquil.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, NOVEMBER 15...Camera Club, 17, John-street, Adelphi, W.C., 8.15 p.m. Mr. J. W. Brushwood, "Printing, Masking, and Toning Cyko Paper."

Geographical Society, Burlington-gardens, W., 8.30 p.m. The President, "The Southern Frontier of Austria."

East India Association, Caxton Hall, Westminster, S.W., 4.15 p.m. Mr. S. N. Singh, "Indian India and its Rajas."

TUESDAY, NOVEMBER 16...Sociological Society, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 5.15 p.m. Mr. P. S. Florence, "The Human Limits to Production."

Petroleum Technologists, Institution of, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Messrs. R. T. Glazebrook, W. F. Higgins, and J. R. Pannell, "The Viscosity of Oil in Relation to the Rate of Flow through Pipes."

Civil Engineers, Institution of, Great George-street, S.W., 5.30 p.m. Sir John Benton, "The Punjab Triple Canal System."

Photographic Society, 35, Russell-square, W.C., 8 p.m. Dr. O. Tugman, "The Resolving Power of Photographic Plates."

Anthropological Institute, 50, Great Russell-street, W.C., 5 p.m. Professor H. J. Fleure and Dr. T. C. James, "The Welsh People: an Anthropological Analysis."

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 4 p.m. Mr. R. L. N. Michell, "Cyprus To-day."

WEDNESDAY, NOVEMBER 17...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 4.30 p.m. Opening Address of the 162nd Session by Dr. Dugald Clerk, "English and German Methods Contrasted."

Meteorological Society, 70, Victoria-street, S.W., 7.30 p.m. 1. Mr. J. S. Dines, "The Mounting and Illumination of Barometers and the Accuracy obtainable in the Readings." 2. Mr. N. A. Comissopulos, "On the Seasonal Variability of Rainfall over the British Isles."

Geological Society, Burlington House, W., 8 p.m.

Microscopical Society, 20, Hanover-square, W., 8 p.m. Messrs. E. Heron-Allen and A. Earland, "The Foraminifera of the Shore Sands and Shallow Water Zone of the South Coast of Cornwall."

Entomological Society, 11, Chandos-street, W., 8 p.m.

Chadwick Public Lecture, at the Royal Sanitary Institute, 90, Buckingham Palace road, S.W., 8.15 p.m. Mr. W. E. Riley, "Some Conclusions on Housing our Workers."

THURSDAY, NOVEMBER 18...Geographical Society, Kensington Gore, S.W., 5 p.m. Mr. C. Wallis, "Distribution of Nationalities in Hungary."

Royal Society, Burlington House, W., 4.30 p.m.

Linnean Society, Burlington House, W., 5 p.m. 1. Mr. W. M. Webb, "Hollow-shafted Feathers." 2. Dr. E. J. Salisbury, "Photographic Studies of Welsh Vegetation."

Child Study Society, at the Royal Sanitary Institute, 90, Buckingham Palace road, S.W., 6 p.m. Dr. P. B. Ballard, "Standards of Proficiency in Reading."

Chemical Society, Burlington House, W., 8.30 p.m. Dr. E. W. Russell, "The Principles of Crop Production."

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mr. W. S. Rowntree, "How the Elephant got his Trunk."

Electrical Engineers, Institution of, Victoria-embankment, W.C., 8 p.m. Presidential Address by Mr. C. P. Sparks.

Historical Society, 22, Russell-square, W.C., 5 p.m. Mrs. H. Jenkinson, "A Forgotten Princess (Joan, daughter of Edward III.)."

FRIDAY, NOVEMBER 19...Dante Society, 38, Conduit-street, W., 3 p.m. Extraordinary Meeting.

Mechanical Engineers, Institution of, at the Institution of Civil Engineers, Great George-street, S.W., 8 p.m. 1. Professors J. O. Arnold and A. A. Read, "The Chemical and Mechanical Relations of Iron, Molybdenum, and Carbon." 2. Dr. J. O. Arnold, "The Cause and Effect of 'Ghost Lines' in Large Steel Forgings."

CONTRIBUTIONS TO THE READING-ROOM.

The Council have to acknowledge, with thanks to the Proprietors, the receipt of the following Transactions of Societies and other Periodicals.

TRANSACTIONS, ETC.

Aëronautical Society, Journal.
African Society, Journal.
American Academy of Arts and Sciences, Proceedings.
American Chemical Society, Journal.
American Institute of Architects, Journal.
American Institute of Electrical Engineers, Transactions.
American Institute of Mining Engineers, Transactions.
American Leather Chemists' Association, Journal.
American Philosophical Society, Proceedings and Transactions.
American Society of Civil Engineers, Transactions.
American Society of Mechanical Engineers, Journal.
Architectural Association, Journal.
Association of Engineering Societies (American), Journal.
Australasian Association for the Advancement of Science, Report.
Australian Official Journal of Patents.
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Barrow and District Association of Engineers, Transactions.
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Bombay, Royal Asiatic Society, Journal.
British Association for the Advancement of Science, Report.
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Society of Biblical Archæology, Proceedings.
Society of Chemical Industry, Journal.
Society of Cymmrodorion, Magazine.
Society of Dyers and Colourists, Journal.
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Miller.
Mining Magazine.
Moniteur Scientifique.
Musical Times.
Paper Maker.
Paper Makers' Monthly Journal.
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Photographic Times (New York).
Plumber and Decorator.
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Pottery and Glass (New York).
Pottery Gazette.
Power User.
Propriété Industrielle (Berne).
Science Abstracts.
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Steamship.
Studio.
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Textile Recorder.
Tropical Life.
United Empire.
War Office Times and Naval Review.
Watchmaker, Jeweller, and Silversmith.
Water and Water Engineering.
Wireless World.

Quarterly.

Agricultural Journal of India.
Botanical Journal.
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Edinburgh Review.
Quarterly Review.
West Indian Bulletin.

NEWSPAPERS.

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South Africa.
Times of Ceylon (Weekly Summary).
Times of India (Overland Weekly Edition).

The issue of many of the Publications formerly received by the Society has been interrupted by the War, and their names have been temporarily removed from this list.

INDEX TO VOL. LXIII.

A.

Abney, Sir William de W., K.C.B., D.C.L., D.Sc., F.R.S., *paper*, testing pigments for permanence of colour, 85
Abyssinia and its trade, 481
Ackermann, A. S. E., B.Sc.(Eng.), A.M.Inst.C.E., *paper*, the utilisation of solar energy, 538; silver medal awarded to, for his paper, 742
Acorns, horse chestnuts, and beech mast, food value of, 19
Aeroplane construction in Australia, 922
——— engineering, 922
Aeroplaning progress in 1914, 345
Afghanistan, agricultural and mineral resources of, 440
Agricultural co-operation in South Australia, 581
Agriculture, Indian, 783
——— in Bengal, 763
——— — England, 699
——— United Kingdom, 924
———, tropical (proceedings of international congress), 258
Aircraft for Italian army, 234
Akabah, capture of, 59
Albert medal, list of awards, 353; presentation to Senator Guglielmo Marconi, G.C.V.O., LL.D., D.Sc., 489; awarded to Professor Sir Joseph John Thomson, O.M., D.Sc., LL.D., F.R.S., 613; annual report, 741
ALDRED LECTURE – L'évolution de l'école Belge de peinture (1830–1900), Paul Lambotte, 469; annual report, 741
Aluminium, 42
Alundum (non-porous) for protecting sheaths of pyrometers, *letter*, Chas. R. Darling, 946
Alward, G. L., *disc.*, the state and the fisherman, 528
Amber industry, German, 852
American mails, 589
Angora goat, 99
Aqueduct in Apulia, 820
Architecture: house building, past and present, *Cantor Lectures* by M. H. Baillie Scott, 989, 1004, 1019, *syllabus*, 351
Armstrong, Sir Charles H., *paper*, Indian trade and the war, 645; silver medal awarded to, for his paper, 742
Armstrong, Professor H. E., the future of indigo, 149
Army clothing, 443
———, the Indian, *paper* by Lieut.-Colonel A. C. Yate, I.A. (retired), 449
Art schools, 933
——— work, annual of, 154
Artesian well, water power from, 80
Arts and crafts, 22, 96, 165, 256, 379, 482, 582, 680, 751, 816, 878, 933, 983
——— at British industries fair, 681
——— (British) at Paris, 165
Asbestos in Tasmania, 700
Ash (volcanic) on the great plains of North America, by Chas. N. Gould, Ph.D., 94
Ashley, Professor W. J., M.A., M.Com., Ph.D., *paper*, the economic position of Germany, 303; silver medal awarded to, for his paper, 742
Asphalt in the State of Oklahoma, by Chas. N. Gould, Ph.D., 132
Atkinson, L. B., *disc.*, measurement of the efficiency of domestic fires, 577
Australia, gold production in, 115
———, northern territory of, *paper* by David Lindsay, 386
———, transcontinental railways of, 114
Australian manufacturers, bounties to, 115
——— rainfall, 423
Automobile parts, shortage of, 62

B.

Baker, T. Thorne, *paper*, industrial uses of radium, 490
Banana flour, 958
Bancroft, Sir Squire, *chair*, Shakespeare's profession, 325
Bank dividends, 170
——— gold reserves, 234
Barker, A. H., *disc.*, measurement of efficiency of domestic fires, 579
Barnes, Sir Hugh S., K.C.S.I., K.C.V.O., *disc.*, Basra and the Shatt-ul-Arab, 517
Barry, James, R.A., "Adam and Eve" presented to the National Gallery of Ireland, 569; annual report, 746
Basket-making, Philippine progress in, 163
Baskets used by German artillery, 21
Basra and the Shatt-ul-Arab, *paper* by Perceval Landon, 505
Bayley, Sir Steuart Colvin, G.C.S.I., C.I.E., *chair*, the Indian indigo industry, 117; *disc.*, tribes of the Brahmaputra valley, 301; *disc.*, the Indian army, 461; annual meeting, 749
Baynes, Alfred Henry, *obituary*, 81
Beadle, Clayton, *disc.*, the empire's resources in paper-making materials, 634
Beale, Octavius Charles, *paper*, expansion of British industry after the war, 221
Beardshaw, William F., *disc.*, recent progress in pyrometry, 607
Bêche-de-mer industry in Bahamas, 426
Beds (metal) in Brazil, 155
Beech mast, acorns, and horse chestnuts, food value of, 19
Beeswax, African wild, 234
Beet (sugar) culture, 138
Belge (comité) pour le commerce avec les alliés, 286
———, l'évolution de l'école, de peinture (1830–1900), *Aldred Lecture* by Paul Lambotte, 469
Belges, Constantin Meunier et les sculpteurs, *Special Lecture* by Paul Lambotte, 669
Belgian intensive culture, 135
——— soldiers comforts fund, 772
——— work at Hammersmith, 755
Belgians, H.M. the King of, Honorary Royal Fellow, 537
Belgium, a short holiday in, by T. B. Grierson, M.Inst.C.E., 805
——— the work of the war refugees' committee, *paper* by Lady Lugard, 429
Benares, industries of, 344
Bengal industries, 690
Bengasi, trade and commerce of, 1913, 944
Bennett, T. J., C.I.E., *disc.*, Indian trade and the war, 661
Berry, A. E., *disc.*, the supply of chemicals to Britain and her dependencies, 34
Besant, Arthur Digby, B.A., F.I.A., Canadian indebtedness, 337
Bhownaggree, Sir Mancherjee M., K.C.I.E., *disc.*, Nepal, 247
Bird sanctuary, Brent valley, 138
Birds, value of, to man, by James Buckland, 701; *letters*, Frank Cundall, 867; J. Buckland, 999
Birmingham power-plant, 346
Biscuits, army, 804
"Bishop Blaize" inns, 871
Bomb calorimeters, standardisation of, 890

Books, Notes on :—
Amphlett, George Thomas, History of the Standard Bank of South Africa, 445
Balls, W. Lawrence, M.A., the Development and Properties of Raw Cotton, 923
Beaumont, Roberts, M.Sc., M.I.Mech.E., Woollen and Worsted, 586
Berry, Henry F., A History of the Royal Dublin Society, 585
Birdwood, Sir George, K.C.I.E., Sva, 349
Bone, Philip J., The Guitar and Mandoline, 41
Calvert, Albert F., Salt in Cheshire, 935
Cressy, Edward, Discoveries and Inventions of the Twentieth Century, 835
Crew, Albert, The Conduct of and Procedure at Public and Company Meetings, 233
Darling, Charles R., Liquid Drops and Globules, 138
Dearle, N. B., Industrial Training, 698
De Villamil, Lieut.-Colonel R., R.E. (retired), Motion of Liquids, 446
Ficke, Arthur Davison, Chats on Japanese Prints, 731
Gage, Professor Simon Henry and Henry Phelps Gage, Optic Projection, 205
Gardner, Walter M., M.Sc., The British Coal-Tar Industry, 986
Gaster, Leon, and J. S. Dow, Modern Illuminants and Illuminating Engineering, 803
Hardy, G. Hurlstone, The Book of the Fly, 698
Holloway, Thomas, Levelling and its General Applications, 819
Humberstone, Thomas Lloyd, An Experiment in Industrial Research, 985
Indian Year Book, 1915, 535
Knox, G. D., The Spirit of the Soil, 984
Knox, Gordon D., Engineering, 715
Leong, Y. K., LL.B., B.Sc.(Econ.), and L. K. Tao, B.Sc.(Econ.), Village and Town Life in China, 642
Levick, Staff-Surgeon G. Murray, R.N., Natural History of the Adélie Penguin, 729
Marshall, Alfred W., M.I.Mech.E., and George Gentry, Micrometers, Slide Gauges, and Calipers, 699
Martin, Edward A., Dew-ponds, 501
Maxwell, J. F., Celtic Scribe Work, 41
Peddie, J. Taylor, F.S.S., First Principles of Production, 485
Pennell, Elizabeth Robins, and Joseph, Lithography and Lithographers, 643
Perris, G. H., Industrial History of Modern England, 233
Phillips' Paper Trade Directory of the World, 1914-15, 923
"Phœnix," The Motor Cyclist's Handbook, 502
Photographic Almanac, British Journal, 1915, 234
Pulbrook, Ernest, The English Countryside, 715
Richardson, S. S., B.Sc., A.R.C.Sc., Magnetism and Electricity, 138
Rivington's Notes on Building Construction, 935
Scott-Mitchell, Frederick, Practical Gilding, Bronzing, Lacquering, and Glass Embossing, 803
Skrimshire, Samuel, F.S.I., Valuations, 643
Todd, John A., B.L., The World's Cotton Crops, 819
Travis, Charles, Railway Rates and Traffic, 154
Victoria and Albert Museum: Review of the Principal Acquisitions, 1914, 731
Victoria and Albert Museum :—(1) Catalogue of the Schreiber Collection of English Porcelain; (2) Guide to the Catalogue of Carpets; (3) Catalogue of a Collection of Miniatures in Plumbago, etc.; (4) Tapestries, 957
Vizetelly, Frank H., Litt.D., LL.D., Essentials of English Speech and Literature, 502
Wireless Telegraphy and Telephony, Year-Book of, 1915, 699
Wireless Time Signals, 936

Books for British civilian prisoners of war in Germany, 867
Boys, Charles Vernon, F.R.S., *chair*, the utilisation of solar energy, 637
Bracken as litter, 982
Brahmaputra valley, tribes of the, *paper* by Captain Sir George Duff Dunbar, Bt., I.A., 290
Brassey, Earl, G.C.B., *disc.*, Indian trade and the war, 661
Bray, Henry F., *letter*, Indian indigo industry, 466
Brenan, Byron, C.M.G., *disc.*, sugar and the war, 270
Bridge building in America, artistic, 973
British Association, 883
British East Africa and Uganda, the economic development of, *paper* by Major E. H. M. Leggett, R.E., D.S.O., 209; *letter*, H. B. Taylor, M.Inst.C.E., 257
British East Africa produce, 724
——— industries fair, 680
——— industry after the war, expansion of, *paper* by Octavius Charles Beale, 221
Broadbent, D. R., *letter*, utilisation of solar energy, 585
Bromley, H.A., *letter*, the empire's resources in paper-making materials, 636
Brooks, F. Vincent, *paper*, British lithography in 1915, 248
Brooms, Italian piuma-grass, 782
Bryce, Right Hon. Viscount, O.M., D.C.L., LL.D., F.R.S., *chair*, the Indian army, 449
Buchanan, George C., C.I.E., M.Inst.C.E., presentation to, of medal for his paper on the port and city of Rangoon, 17
Buckland, James, the value of birds to man, 701; *letter*, do., 999
Budget changes and textile industries, 956
Buffer stops: a frictional device, 666
Building (house), past and present, *Cantor Lectures* by M. H. Baillie Scott, 989, 1004, 1019; *syllabus*, 351
Bunder Abbas and its trade, 607
Burlton, C. H. B., *letter*, Indian trade and the war, 682
Burton, T. R., *disc.*, testing pigments for permanence of colour, 93
Busrah, British in, 134
Buxton, Sir Thomas Fowell, Bt., G.C.M.G., *obituary*, 1015

Cacao (export of) from Ecuador, 1034
——— in the Dominican republic, 784
Calendar for 1914-15, 5
Canada, hydrographic work in, 499
———, military engineering in, 466
———, trade outlook and the war, 114
———, war equipment from, 422
Canadian and British trade, 498
——— indebtedness, by Arthur Digby Besant, B.A., F.I.A., 337
——— industrial and labour conditions, 423
Canal haulage, electric, 152
——— (Panama) defences, 666
———, from an Italian point of view, 480
——— traffic, 79, 99
———, Suez, 81
——— in war time, 644
Cantor Lectures :—*Notices* of publication of reprints, 237, 947, 989; annual report, 740
1st Course:—"The history and practice of the art of printing," by R. A. Peddie, 101, 129, 142, 158; *syllabus*, 2
2nd Course:—"Oils, their production and manufacture," by F. Mollwo Perkin, Ph.D., F.I.C., F.C.S., M.Inst.P.T., 837, 853, 869; *syllabus*, 156
3rd Course:—"House building: past and present," by M. H. Baillie Scott, 989, 1004, 1019; *syllabus*, 351
4th Course:—"Foodstuffs," by David Sommerville, B.A., M.Sc., M.D., 893, 909, 925, 937
Cascara sagrada, 1034
Cassal, Colonel Charles E., *disc.*, the supply of chemicals to Britain and her dependencies, 36
Catalogues, exhibition of German trade, 716
Cedar, British Columbia red, 382
Cement in Queensland, 803
——— the Canary Islands, market for, 24
——— manufacture in India, 666
——— protected steel construction, 801
——— trade in Brazil, 441
Chadwick Lectures, 946

Chadwin, W. T., *disc.*, sugar and the war, 269
Chapman, A. Chaston, *disc.*, the supply of chemicals to Britain and her dependencies, 35
Charities, "Quarterly Review" and British, 111
Chemical trade, Britain and Germany in relation to the: *paper* by William Reginald Ormandy, D.Sc., F.C.S., 47; *letter*, R. Le Neve Foster, 167
Chemicals, supply of, to Britain and her dependencies, *paper* by Sir William A. Tilden, D.Sc., LL.D., F.R.S., 26
Chemists (industrial), training of, *letters*, W. J. Dibdin, 81; Chas. R. Darling, 98
Chengtu district, resources of, 782
China, canals of, 1016
—— electric machinery in, 852
——, engineering openings in, 903
—— (Kaihsian district), resources of, 954
——, railway and industrial schemes in, 636
—— (South), coal fields in, 981
——, Yunnan province, trade prospects in, 904
Chinese market for machinery, 567
—— native trades in Shensi, 150
Chisholm, Robert Fellowes, F.R.I.B.A., *obituary*, 697
Choco intendency, development of, 202
Chrimes, Charles Edward, *obituary*, 154
Christison, G. W., *disc.*, Nepal, 246
Christmas and the artistic crafts, 97
Cider, concentrated apple, in America, 464
Clerk, Dugald, D.Sc., F.R.S., *chair*, patent law reform, 356; elected chairman of council, 789
Clothing, economy in, 906
Cloths and skirts, 445
Coal distillation, products of, 813
—— in China, 880, 981
—— Germany, output of, 287
—— Sweden, 892
—— the United Kingdom, 1914, 732
—— industry, Japan, 82
—— measures of Queensland, 285
—— tar dye industry, 1033
—— (world's) in 1912, 286
Cocoa-bean coating in Trinidad, 317
Coconut cake as cattle food, 684
—— industry, 726
—— -water as rubber coagulant, 259
Coffee supply, far eastern, 908
Cole, Alan S., C.B., *letters*, map-making and tapestries, 40; decorative textile industries and designer's relation thereto, 282
Colebrook, Frank, *disc.*, British lithography in 1915, 253
College, Chinese conservancy engineering, 535
"Collegium," 186
Collier, the Hon. John, *paper*, portrait painting: the technique of the great masters, 189; silver medal awarded to, for his paper, 742

COLONIAL SECTION:—Annual report, 739; list of committee, 909
1st Meeting:—"The economic development of British East Africa and Uganda," by Major E. H. M. Leggett, R.E., D.S.O., 209
2nd Meeting:—"Sugar and the War," by Edward R. Davson, 261
3rd Meeting:—"The Northern Territory of Australia," by David Lindsay, 386
4th Meeting:—"The empire's resources in paper-making materials," by S. Chas. Phillips, M.S.C.I., 613

Colour, testing pigments for permanence of, *paper* by Sir William de W. Abney, K.C.B., D.C.L., D.Sc., F.R.S., 85
Colour-schemes, spring, 583
Conciliation courts in France, 38
Concrete arch, flat long-span, 866
—— in waterworks construction, 566
Concreting, electric car heaters for cold weather, 975
Contracts, government, 61
Cooking of hams, etc., in tins, 800
Copley, John, *disc.*, British lithography in 1915, 252
Copper for shells, Canadian, 976
Copra, Philippine, 697
Cork dust in Spanish fruit packing, use of, 382
Corn, new method of growing, 820
Corrosion of condenser tubes, 666
Corrugation, rail, 866
Cotton accoutrements, 61
—— as contraband, 851
—— crop in Russia, 876
—— cultivation in Uganda, 17
—— explosives, 786
—— fibre, coloured, 955
—— (fine sea island) in West Indies, 148
—— for paper, 155
—— in British India, improvement of, 37
—— Korea, 996
—— Manchuria, 868
—— Uganda, 668
—— industry of the Leeward Islands colony, 58
——, introduction of American, into Sind province, 135
——, Madras crop, 1914–15, 611
—— mills in China, 769
—— stalks, utilising, 580
—— waste in India, 868, 906
—— year book, 534
Cottons and woollens, continental, 318
——, foreign, 136
Council, 1914-15, 1; Hon. Richard Clere Parsons, M.A., elected a member, 261; annual report, 733; 1915-16, annual report, 747; elected, 750; Dugald Clerk, D.Sc., F.R.S., elected chairman, 789
Crace, J. D., *disc.*, testing pigments for permanence of colour, 92; *letter*, decorative textile industries and the designer's relation thereto, 320
Crane, failure of Panama Canal, 465
——, monster locomotive, 466
Cream-separator industry, Sweden, 427
Crewe, Most Hon. the Marquess of, K.G., P.C., *chair*, Indian trade and the war, 645
Crosthwaite, Sir Charles Haukes Todd, K.C.S.I., *obituary*, 683
Croysdale, T., *disc.*, Indian indigo industry, 126
Cuba, timber resources of, 350
Cundall, Frank, *letter*, the value of birds to man, 867
Cunningham, Lieut.-Colonel Allan, J. C., *disc.*, the utilisation of solar energy, 564; *disc.*, measurement of efficiency of domestic fires, 579
Curzon of Kedleston, the Right Hon. Earl, G.C.S.I., G.C.I.E., *chair*, Basra and the Shatt-ul-Arab, 505
Cutch in Malaya, 442; *letter*, Harington G. Forbes, 484
Cyprus, annexation of, 39

D

Dairy industry in Eastern Siberia, 42
—— of Great Britain, 107
—— Switzerland, 426
d'Almeida, George, British Malaya, 719; trade of the Straits Settlements, 877
Dane, Sir Louis William, G.C.I.E., C.S.I., *disc.*, Nepal, 245
Darling, Chas. R., *letter*, the training of industrial chemists, 98; *paper*, recent progress in pyrometry, 590; silver medal awarded to, for his paper, 742; *lecture*, field telephones, 881; *letter*, non-porous alundum for protecting sheaths of pyrometers, 946
Davidson, Thomas A., F.C.S., *disc.*, testing pigments for permanence of colour, 93
Davson, Edward R., *paper*, sugar and the war, 262; silver medal awarded to, for his paper, 742
Debts, foreign, 444
"Delmira," unsinkable s.s., 788
Denbigh, Earl of, C.V.O., *letter*, sugar and the war, 270
Desborough, Right Hon. Lord, K.C.V.O., *chair*, sugar and the war, 261
Design and industries association, 682, 983
—— and industry, 483
—— at British industries fair, 680; *letter*, Arthur Wilcock, 715
—— (industrial), certificates in, 817
——, studio of practical, 958
——, the Slav feeling for, 816

Designer's relation thereto, decorative textile industries and, *paper* by Arthur Wilcock, 271 ; *letters*, J. D. Crace, Chas. A. Eva, A.R.C.A., and W. G. Paulson Townsend, 320–1 ; Arthur Wilcock, 346 ; R. H. Garton, 348 ; Eric Newman, 348 ; R. E. Green, 381 ; Clarence Mawson, A.R.C.A., 424
Designs, German and Austro-Hungarian textile, 256
———, use of, 444
De Villamil, Lieut.-Colonel R., *letter*, motion of liquids, 583
Diamond industry of Netherlands, 905
Dibdin, W. J., *letter*, training of industrial chemists, 81
Diesel engine, large, 566
Diesel-engined warship, 81
Diving dress, all-metal, 153
Dobbie, Professor James J LL.D., D.Sc., F.R.S., *disc.*, the supply of chemicals to Britain and her dependencies, 34
Doll-making in Staffordshire, 661
do Nascimento, José Custodio Fernandes, *obituary*, 610
Douie, Sir James, K.C.S I., presentation to, of medal for his paper on the Punjab canal colonies, 17
Doyle, Kinsley D. *letter*, hides and tannin extract of quebracho, 98
Dry-farming in India, 953
Duke, Sir William, K.C.I E., C.S.I. *disc*, Indian indigo industry, 126
Dunbar, Captain Sir George Duff, Bt. I.A, *paper*, tribes of the Brahmaputra valley, 290 ; silver medal awarded to, for his paper, 742
Dunstan, Professor Wyndham R, C.M G., F R S, *disc*, measurement of efficiency of domestic fires, 578
Durand, Sir Edward, Bt., C.B, *disc*, expansion of British industry after the war, 230
Durand, Right Hon. Sir Mortimer, G C M G, K C.S I, K C.I E., vote of thanks to chairman of council, 17, *disc*, the Indian army, 463
Dye (coal-tar) industry, 1033
——, embargo on exports of, from Italy, 139
—— industry, British, 78
—— khaki, 863
——, osage orange wood, 956
—— woods (khaki) from West Indies and South Africa, 609
Dyed goods, 850
Dyes, natural, 533
Dyestuffs and dyers, 204
——— co-operative, 444
——— manufacture, 1015
——— state-aided, 61
Dyeware famine, 713
Dyewares, British, 61, 137

E.

Eastick, J. J., F.C.S., M.S.C.I., *disc.*, sugar and the war, 269
Eau de Cologne, a French product, 322
———, production of, 532
Edgerley, Sir Steyning William, K C.V.O., C.I.E., *disc*, Nepal, 247 ; *disc.*, tribes of the Brahmaputra valley, 302, *disc.*, the Indian army, 463 ; *disc.*, Indian trade and the war, 661
Education, industrial, 1014
Eggs in Shantung, 206
Egret and heron rearing in Madagascar, 716
Electric locomotives, high-speed, 232
——— railway progress in England, 923 (*see also* under "Railways")
——— traction, recent developments in, 865
Electrical museum, 819
Electricity (cultivation by) in Italy, 287
Elephant catching : the pit method, 723
Elwes, Henry John, F.R S., *paper*, Nepal, 238
Embroidery and trimmings, British, *letter*, F. Edith Giles, 23
———, eastern and western, 167
Emeralds : their mode of occurrence and methods of mining and extraction in Colombia, by Charles Olden, 685
Emigration, decline in, 284
Empire generosity and unity, 113
Empire notes, 39, 118, 184, 284, 422, 498, 608
Engine (internal-combustion) on the oilfield, 468
Engineering notes, 80, 151, 231, 345, 464, 565, 665, 727, 801, 865, 922, 973, 1031
——— representation abroad, 974
Engines, large submarine, 802
Esparto industry of Spain, 343
Eva, Chas. A., A.R.C.A., *letter*, decorative textile industries and the designer's relation thereto, 320
Evans, P. M., *disc.*, textile industries of Great Britain and of Germany, 183
Ewing, William, *obituary*, 232
EXAMINATIONS, ROYAL SOCIETY OF ARTS, 1915, *notices*, 237, 569, 589, 685, 701, 733, 789, 925, 1017 ; number of entries, 1915, 489 ; annual report, 743 ; time tables, 1916, 790–1 ; report on, 959 ; for Belgian refugees, *notice*, 977
  Music, practical, 1914, annual report, 745
  Vivâ voce in modern languages, 746
EXHIBITIONS :—
  Anglo-Russian Building Trades and Decorative Arts, 187
  British industries fair, 486, 680
  Canadian National, 468
  Central School of Arts and Crafts, 257
  Englishwoman, 22, 946
  German and Austro-Hungarian Textiles, 256, 318
  Goldsmiths' Hall, 482 ; *letter*, Harry Peach, 641
  Liége, proposed war, 946
  Professional classes war relief, 82
  Royal College of Art, 880
  San Francisco, 42, 284, 322 ; awards to British exhibitors, 907 ; engineering congress, 946
  Whistler, 684
  Whitechapel Art Gallery, 582
  Whitechapel, Printing, 984
Exploration (Russian) in the Arctic sea, 784

F.

Fabrics, strength of, 907
Fans, 96
Federated Malay States, agriculture in, 891
Fell, Arthur, M P., presentation to, of medal for his paper on the Channel tunnel, 16
Fellows, alien enemy, annual report, 746
———, honorary royal, annual report, 746
———, list of, *notice*, 45
Fells, J. M., *disc.*, expansion of British industry after the war, 230
Ferguson, W. B., K.C., *disc*, testing pigments for permanence of colour, 92
Fibre producer, water hyacinth as, 235
Fiji, progress of, 500
Finance, annual report, 748
Financial statement, 1914–15, 717
Fires, on the measurement of the efficiency of domestic, and on a simple and smokeless grate, *paper* by Augustus Vernon Harcourt, D.C.L., LL D., D.Sc., F.R.S., 570
Fish frozen alive, 63
Fisheries, colonial, 422
———, Greek, 426
———, Natal, 750
———, New Zealand, 587
——— of India, chank, 904
Fisherman, the state and the, *paper* by Moreton Frewen, 520
Flax prospects in Canada, 609
Fleming, Professor J. A, F.R S., science in the war and after the war, 977
Flies and mosquitoes, extermination of, 479 ; *letter*, G. Bertram Kershaw, 501
—— (house) and disease, *letter*, H. T. Geoghegan, 641
Flour and grain (imports of), to France, 287
Flower trade between France and Italy, 479
Fly exhibition, Zoological Gardens, 664
Fodder, autumn and winter, 951
Foochow, trade of, 848
Food, economy in, 804
—— frauds in war, German, 835

Foodstuffs, *Cantor Lectures* by David Sommerville B A , M.Sc., M.D.. 893, 909, 925, 937
Forbes, Harington G., *letter*, cutch in Malaya, 484
Forest fires in the south of France, 163
Forests, Indian, 932
——— of France, 945
Forster, Dr M O , F.R S , *disc* , Britain and Germany in relation to the chemical trade, 56
Fortifications, concrete *versus* earthworks, 465
Foster, Alfred W., *disc* , the empire's resources in paper-making materials, 633
Foster, Bernard Le Neve, J P , *obituary*, 348
Foster, Charles E., *disc* , recent progress in pyrometry, 605
Foster, R. Le Neve, *letter*, Britain and Germany in relation to the chemical trade, 167

FOTHERGILL LECTURES. Modern munitions of war, by Professor Vivian B. Lewes, F I.C , F.C S , *notice*, 701 ; annual report, 747; report, 821
Motor fuels, by Professor Vivian B Lewes F I C , F.C S , 757, 773, 792 , *syllabus*, 236 , annual report, 741 ; notice of reprint, 837

Foxton, W , *disc* , decorative textile industries and the designer's relation thereto, 282
France, agricultural resources of, 487
———, effect of war on foreign trade of, 611
French custom house, increasing revenue of, 668
——— departments occupied by German troops, iron and steel industries in, 443
Frewen, Moreton, *paper*, the state and the fisherman, 520
Fryer, Sir Frederic W R , K C S I , *disc* , British East Africa and Uganda 220
Fuel, manufacture of patent 974
Fuels motor, *Fothergill Lectures* by Professor Vivian B Lewes, F I C , F C S , 757, 773, 792 *syllabus* 236 , annual report, 741

G.

Gambia trade of, 322
Garnett, Dr W , *disc* decorative textile industries and the designer's relation thereto, 281
Garton, R H , *letter* decorative textile industries and the designer's relation thereto, 348
Gas (coal) for industrial purposes, uses of, *paper* by H M Thornton, M I Mech E 401
——— (natural) in Canada, 868
Gasoline (petrol) from natural gas in the oil-fields of Oklahoma, by Chas. N Gould, 694
Gaster, Leon, *disc* , uses of coal gas for industrial purposes 421
Generator, large direct-current at Detroit, 666
Genoa, increase of trade of, 287
———, quay accommodation at port of, 441
Geoghegan, H T , *letter*, house-flies and disease, 641
Georgian Bay islands, 185
German East Africa, 764
——— exports to Russia before the war, 751
——— patterns in textiles, 256, 786
——— trade in India, 1016
Germany, present state of engineering in, 729
———, raw materials of, 1011
——— , the economic position of, *paper* by Professor W J Ashley, M.A , M Com , Ph D , 303
Giles, F. Edith *letter*, British trimmings and embroidery, 23
Glantawe, Lord, *obituary*, 818
Glass factories in United Provinces, 771
———, optical, 683
——— research, 662
——— stained, 754, 983
Gold-mining in Western Australia, 499
Gooday, John Francis Sykes, *obituary*, 186
Goodenough, F W , *disc* , uses of coal gas for industrial purposes, 420 , *chair*, on the measurement of the efficiency of domestic fires, 570
Gordon, John William, K C , *paper*, patent law reform 356
Gould, Chas. N., Ph.D., occurrence of volcanic ash on the plains of North America, 94 ; asphalt in the state of Oklahoma, 132 , gypsum deposits in the state of Oklahoma, 202 ; salt in Oklahoma, 255 , manufacture of gasoline (petrol) from natural gas in the oil-fields of Oklahoma, 694 , prospecting for oil and gas in North America, 721
Gowland, Professor William, F R S , *chair*, domestic metal work of the eighteenth century, 65
Grate, on the measurement of the efficiency of domestic fires, and on a simple and smokeless, *paper* by Augustus Vernon Harcourt, D C L , LL D , D Sc , F R S , 570
Greek mercantile marine, 732
Green, Professor A G , M Sc , *disc* , the supply of chemicals to Britain and her dependencies, 35
Green, R E , *letter*, the decorative textile industries and the designer's relation thereto, 381
Greene, H Plunket, *Juvenile Lectures*, how to sing a song, *report*, 141, 157
Grierson, T B M Inst C E , a short holiday in Belgium, 805
Ground-nuts, 535
——— in Northern Argentina, 679
Groynes and sea walls, 234
Guedalla, F M , *disc* , the work of the war refugees' committee, 439
Gum (Kauri) in New Zealand 766
Guns, big, 665
Gypsum deposits of the state of Oklahoma, by Chas N. Gould, Ph D , 202

H.

Hadfield Sir Robert Abbott, D Sc F R S , *chair*, recent progress in pyrometry, 589
Hair (human), trade in, 880
Hammersmith arts and crafts, 755
Harcourt Augustus Vernon, D C L LL D , D Sc. F R S , *paper*, on the measurement of the efficiency of domestic fires and on a simple and smokeless grate, 570
Hardingham, G G M *disc* , patent law reform, 376 , *letter*, do , 425
Harker, Dr J A , F R S *disc* recent progress in pyrometry, 606
Harris, Jonathan James *obituary*, 683
Harrison, Charles, *disc* , testing pigments for permanence of colour, 92
Hartley Sir Charles Augustus K C M G M Inst C E , *obituary* 322
Hartley H , *disc* measurement of efficiency of domestic fires, 579
Hats Panama 164, 769
Hawkshaw, John Clarke, M A , M Inst C E presentation to, of medal for his paper on the early history of the Channel tunnel, 16
Hay, Sir Lewis J E Bt , *letters*, Indian indigo industry, 153, 167
Hederstedt, Henry Burdett, M Inst C E , *obituary*, 610
Hele-Shaw, H S , D Sc , LL D , F R S organisation, 947
Hendley Colonel T Holbein, C I E , presentation to of medal for his paper on Indian museums, 17
Henequen in Mexico, new uses for by-products of 480
Hides and tannin extract of quebracho, *letter*, Kinsley D Doyle 98
Hindu piece-goods tickets, 1030
Holdich Colonel Sir Thomas H , R E K C M G , K C I E , C B , D Sc , chairman's address (map-making) 6 , *chair*, testing pigments for permanence of colour, 85 , *disc* , portrait painting, 200 , *chair*, sugar and the war, 261 , *disc* , tribes of the Brahmaputra valley, 300 , *chair*, the work of the war refugees' committee, 429 , *disc* , the Indian army, 462 , *disc* , Basra and the Shatt-ul-Arab, 518 , *chair*, annual general meeting, 733
Hong-Kong's wireless station, 487
Hooper George Norgate, *obituary* 186
Horse-chestnuts, acorns and beech mast food value of, 19
House building past and present, *Cantor Lectures* by M H. Baillie Scott, 989, 1004, 1019 , *syllabus*, 351

Humphreys-Davies, George, *obituary*, 610
Hunter, Campbell M., *disc.*, uses of coal gas for industrial purposes, 421, 448
Hunter, J. A., *paper*, the textile industries of Great Britain and of Germany, 174; silver medal awarded to, for his paper, 742
Hydraulic mining cartridge, 20
Hydro-electric plant, Iowa, 866
———— power in Ireland, 728
———— ———— Sweden, 727
———— works, Big Creek, 875

I.

Imperial Institute, 350, 447
Inca and pre-Inca discoveries, 464
India, dry-farming in, 953
——, electrical enterprise in, 729
——, enemy trade in, 62, 82
——, industrial development of United Provinces, 831
——, veterinary work in, 945

Indian Section:—Meetings of committee, 25, 805, 1018; annual report, 737; list of committee, 893
1st Meeting:—"The Indian indigo industry," by F. Mollwo Perkin, Ph.D., F.I.C., F.C.S., 117
2nd Meeting:—"Nepal," by Henry John Elwes, F.R.S., 237
3rd Meeting:—"Tribes of the Brahmaputra valley," by Captain Sir George Duff Dunbar, Bt., I.A., 289
4th Meeting:—"The Indian Army," by Lieut.-Colonel A. C. Yate, I.A. (retired), 449
5th Meeting:—"Basra and the Shatt-ul-Arab," by Perceval Landon, 505
6th Meeting:—"Indian trade and the war," by Sir Charles H. Armstrong, 645

Indian agriculture, 783
——— army, *paper* by Lieut.-Colonel A. C. Yate, I.A. (retired), 449
——— crops, 567
——— forests, 932
——— manufactures and present opportunity, 423
——— post and telegraph department, 185
——— trade and the war, 322; *paper* by Sir Charles H. Armstrong, 645, *letter*, C. H. B. Burlton, 682
——— ——— in 1914, 804
Indigo conference, 258
———, future of, by Professor H. E. Armstrong, 149
———, Indian, 716, 732
——— industry, Indian, *paper* by F. Mollwo Perkin, Ph.D., F.I.C., F.C.S., 117; *letters*, Sir Lewis J. E. Hay, 153, 167; Henry F. Bray, 466
——— market for, in China, 187
Industry and finance, 1014
———, expansion of British, after the war, *paper* by Octavius Charles Beale, 221
Inks, printing, 756
Inoculation against typhoid, 206, 500
Invention in 1914, trend of, 849
Inventions and simplicity, 205
———— Board, 804
———— Development Association, 802
———— (Munitions) Department, *letter*, E. W. Moir, 947
Ipecacuanha, 820
Iron and steel, "calorising" coating, 880
——— ——— industries in French departments occupied by German troops, 443
——— ——— institute, 924
——— in ancient India, 43
——— (malleable) industry, 346
——— ore surveys in the Philippines, 783
Irrigation in India and Burma, 728, 876
Italian seaports, movement of shipping at, 668
Italy ancient Teuton colony in, 833
———, business with, 976
Ivory (vegetable) exports from Ecuador, 317

J.

James, Sir Evan, K.C.I.E., C.S.I., *disc.*, Indian indigo industry, 127; *disc.*, Nepal, 245
Japan, flour-milling industry in, 503
———, foreign trade of, 852
———, home-colonisation in, 695
——— in 1914, commercial situation in, 814
———, machinery trade in, 864
Japanese knitting yarns in Hong-Kong, 908
———— naval shipyards, 1914, 804
———— railway development, 836
Jardine, Sir John, M.P., K.C.I.E., *disc.*, Basra and the Shatt-ul-Arab, 519
Jenkins, Henry, *disc.*, the utilisation of solar energy, 564
Jenkins, Henry C., *disc.*, recent progress in pyrometry, 606
Jenkins, Hon. J. G., *disc.*, expansion of British industry after the war, 230; *disc.*, the northern territory of Australia, 399
Jewellery, 582
Jones, G. E., *letter*, utilisation of solar energy, 584
Jones, G. W., *disc.*, British lithography in 1915, 252
Journal, white cover for, 869
Juvenile Lectures, how to sing a song, by H. Plunket Greene, *notice*, 25; report, 141, 157; annual report, 741

K.

Kapok cultivation in Ceylon, 481
——— fibre, 320
Keeble, Professor F., F.R.S., *disc.*, industrial uses of radium, 496
Kelp, industry in Scotland, 611
————, Irish, 712
———, production of potash from, in U.S.A., 587
Kershaw, G. Bertram, *letter*, extermination of flies and mosquitoes, 501
Kintore, Right Hon. the Earl of, G.C.M.G., *letter*, the northern territory of Australia, 400
Korea, tobacco, ginseng, and cotton in, 996

L.

Laboratory ware, 207
Labour market in March, 611
Lace, 380, 934
Lahore memorial to King Edward, 610
Laidlaw, Sir Robert, *obituary*, 1033
Lalaing, M. le Comte de, *disc.*, work of the war refugees' committee, 439
Lamb, Sir John Cameron, C.B., C.M.G., *obituary*, 467
Lambotte, Paul, *Aldred Lecture*, l'évolution de l'école Belge de peinture (1830–1900), 469; *Special Lecture*, Constantin Meunier et les sculpteurs belges de son temps, 669; annual report, 741; silver medal awarded to, for his special lecture, 742
Lamps, Ediswan electric, 770
Landon, Perceval, *paper*, Basra and the Shatt-ul-Arab, 505; silver medal awarded to, for his paper, 742
Lapland, mining difficulties in, 922
Leather goods in China, demand for, 680
———, Nigerian and Somaliland, 531
——— trade, Indian, 503
Leechman, D., *disc.*, patent law reform, 376
Leeson, W. F., *disc.*, expansion of British industry after the war, 231
Legge, Dr. T. M., *disc.*, measurement of efficiency of domestic fires, 578
Leggett, Major E. H. M., R.E., D.S.O., *paper*, the economic development of British East Africa and Uganda, 209; silver medal awarded to, for his paper, 742
Leigh, Evan Arthur, *obituary*, 787
Leon torpedo, 1031
Lettering, illumination, and printing, 166
Lewes, Professor Vivian B., F.I.C., F.C.S., *Special War Lectures*, modern munitions of war, *notice*, 701, 821, *Fothergill Lectures*, motor fuels, 757, 773, 792; *syllabus*, 236; annual report, 741; *obituary*, 1000

Library, contributions to, 987
Lighting, mill, 956
Limestone (self-burning) in Syria, 316
Lindsay, David, and the northern territory of Australia, 185; *paper*, the northern territory of Australia, 386
Linen industry, Russian, 892
Linoleum in Norway, 115
Liquids, motion of, *letter*, Lieut.-Colonel R. de Villamil, 583
Lithography (British) in 1915, *paper* by F. Vincent Brooks, 248
Locomotive, first, 345
Long, the Right Hon. Walter Hume, LL.D., F.R.S., M.P., *chair*, the state and the fisherman, 519
Loom, largest, 62
Looms, efficiency of, 640
Lovibond, Joseph W., *disc.*, testing pigments for permanence of colour, 93
Lugard, Lady, *disc.*, British East Africa and Uganda, 218; *paper*, the work of the war refugees' committee, 429
Lyall, Sir Charles J., K.C.S.I., C.I.E., *disc.*, tribes of the Brahmaputra valley, 301

M.

Macbride, Professor E. W., F.R.S., *disc.*, the state and the fisherman, 528
McCall, Hon. Sir John, M.D., LL.D., *disc.*, expansion of British industry after the war, 229; *disc.*, the empire's resources in paper-making materials, 636
MacGregor, the Right Hon. Sir William, G.C.M.G., *disc.*, the northern territory of Australia, 398
McHardy, David, *obituary*, 818
McLeod, C. C., *disc.*, Indian trade and the war, 658
McRobert, Sir Alexander, *disc.*, Indian trade and the war, 660
Machinery (foreign) in the Yangtsze valley, 699
Machines and hand production, 956
Madagascar, wild citrus fruits of, 467
Madeira, commerce and industries of, 95
Magnet for removing metal from flesh, 866
Magnus, Sir Philip, M.P., *disc.*, textile industries of Great Britain and of Germany, 185; *letter*, patent law reform, 445; annual meeting, 750
Mahua or illupei tree of India, 785
Malaya, British, by George d'Almeida, 719
Mangoes, preserved, 1034
Manjack deposits in British West Indies, 891
Map-making, chairman's address by Colonel Sir Thomas H. Holdich, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., 6; *letter*, Alan S. Cole, C.B., 40
Marconi, Senator Guglielmo, G.C.V.O., LL.D., D.Sc., Albert medal presented to, 489
Marseilles, movement of shipping at, 1914, 463
Massey, W. H., *disc.*, the utilisation of solar energy, 564; *letter*, do., 584
Mathieson, Wilfrid, *letter*, Indian indigo industry, 129
Maw, Dr. W. H., *chair*, Britain and Germany in relation to the chemical trade, 47
Mawson, Clarence, A.R.C.A., *letter*, decorative textile industries and the designer's relation thereto, 424
Maxwell, Right Hon. Sir Herbert, Bt., F.R.S., *chair*, Nepal, 237
Meat in Germany before the war, consumption of, 286
MEDALS:—
Albert, list of awards, 353; presentation to Senator Guglielmo Marconi, G.C.V.O., LL.D., D.Sc., 489; awarded to Professor Sir Joseph John Thomson, O.M., D.Sc., LL.D., F.R.S., 613; annual report, 741
Society's silver medals for *papers* read Session 1913-14, presented, 16; 1914-15 awards (annual report), 742
Medicinal plants, 667
MEETINGS OF THE 161ST SESSION:—
ALDRED LECTURE (*see* "Aldred")
ANNUAL MEETING, *notice*, 701; report of meeting, 733
CANTOR LECTURES (*see* "Cantor")
COLONIAL SECTION (*see* "Colonial")
FOTHERGILL LECTURES (*see* "Fothergill")
INDIAN SECTION (*see* "Indian")
MEETINGS, ORDINARY:— Annual report, 735
1st Meeting:—Opening address by Colonel Sir Thomas H. Holdich, R.E., K.C.M.G., K.C.I.E., C.B., D.Sc., 6
2nd Meeting:—"The supply of chemicals to Britain and her dependencies," by Sir William A. Tilden, D.Sc., LL.D., F.R.S., 25
3rd Meeting:—"Britain and Germany in relation to the chemical trade," by William Reginald Ormandy, D.Sc., F.C.S., 45
4th Meeting:—"Domestic metal work of the eighteenth century," by Wm. A. Young, 65
5th Meeting:—"Testing pigments for permanence of colour," by Sir William de W. Abney, K.C.B., D.C.L., D.Sc., F.R.S., 85
6th Meeting:—"The textile industries of Great Britain and of Germany," by J. A. Hunter, 173
7th Meeting:—"Portrait painting: the technique of the great masters," by the Hon. John Collier, 189
8th Meeting:—"Expansion of British industry after the war," by Octavius Charles Beale, 220
9th Meeting:—"British lithography in 1915," by F. Vincent Brooks, 247
10th Meeting:—"Decorative textile industries, and the designer's relation thereto," by Arthur Wilcock, 271
11th Meeting:—"The economic position of Germany," by Professor W. J. Ashley, M.A., M.Com., Ph.D., 303
12th Meeting:—"Shakespeare's profession," by William Poel, 325
13th Meeting:—"Patent law reform," by John William Gordon, K.C., 356
14th Meeting:—"The uses of coal gas for industrial purposes," by H. M. Thornton, M.I.Mech.E., 401
15th Meeting:—"The work of the war refugees' committee," by Lady Lugard, 429
16th Meeting:—"The industrial uses of radium," by T. Thorne Baker, 490
17th Meeting:—"The state and the fisherman," by Moreton Frewen, 519
18th Meeting:—"The utilisation of solar energy," by A. S. E. Ackermann, B.Sc.(Eng.), A.M.Inst.C.E., 537
19th Meeting:—"On the measurement of the efficiency of domestic fires, and on a simple smokeless grate," by Augustus Vernon Harcourt, D.C.L., LL.D., D.Sc., F.R.S., 570
20th Meeting:—"Recent progress in pyrometry," by Chas. R. Darling, A.R.C.Sc.I., 589
SPECIAL LECTURE:—"Constantin Meunier et les sculpteurs Belges de son temps," by Paul Lambotte, 669; annual report, 741
SPECIAL WAR LECTURE:—*Notice*, 789; "Field telephones," by Charles Darling, A.R.C.Sc.I., 881
Meetings, hour of, 959
Memorial tablets, 115; first English theatre, 936
Mercantile marine of the world, 486
Mercerising in acid, 137
Messel, Dr. Rudolph, F.R.S., *disc.*, Britain and Germany in relation to the chemical trade, 56
Mestrovic, Ivan, works of, 816
Metals, munition, 799
Metalwork and jewellery, 96
———— (domestic) of the eighteenth century, *paper* by Wm. A. Young, 66
Meunier (Constantin) et les sculpteurs belges de son temps, *Special Lecture* by Paul Lambotte, 669
Mica in Canada, 667
——— India, 976
Milan and Lombardy, foreign population of, 463
Military academy at Quetta, 644
——— training in schools, 997
Milnes, Alfred, *disc.*, the economic position of Germany, 314
Mining cartridge, hydraulic, 20
Mitchell, A. H., *letter*, destruction of wasps, 891
Mitchell, P. Chalmers, M.A., D.Sc., F.R.S., presentation to, of medal for his paper on zoological gardens, 16
Moir, E. W., *letter*, munitions inventions department, 947
Molasses, new lubricant from, 772
———— problem in Cuba, 768

Molybdenum, Australian 587
——————, Canadian, 932
Moore, Lieut.-Colonel the Hon. Sir James Newton, K.C.M.G., *disc.*, the northern territory of Australia, 397
Moore, R. A. Leslie, *disc.*, Nepal, 245
Morris, Sir Daniel, K.C.M.G., D.C.L., D.Sc., *disc.*, the empire's resources in paper-making materials, 633
Morse, Samuel, and the Society of Arts, 448
Motor-cars and tyres (American) for England and France, 1001
———— in Norway, 503
———— fishing-boats in Scotland, 998
———— plough, 1032
Motors (marine) for China, 799
Moulton, Right Hon. Lord, P.C., LL.D., F.R.S., *chair*, Britain and Germany in relation to the chemical trade, 45; on British dye industry, 78
Munition metals, 799; *letter*, William T Taylor, 851
Munitions inventions department, *letter*, E. W. Moir, 947
———— of war, modern, *Fothergill Lectures* by Professor Vivian B. Lewes, F.I.C., F.C.S., 821
Murray river storage scheme, 285
Museum (commercial) in Calcutta, 1033
———————— Teneriffe, 323

N.

Naples, labour conditions in 1913, 150
Nasmith, Frank, *disc.*, textile industries of Great Britain and of Germany, 183
National competition, 878, 936
———— Physical Laboratory, 820
Naval construction in Europe, 134
Negro farmer in the United States, social and economic progress of, 95
Nepal, *paper* by Henry John Elwes, F.R.S., 238
Newman, Eric, *letter*, decorative textile industries and the designer's relation thereto, 348
New Zealand, railway progress in, 499
Noble, Captain Sir Andrew, Bt., K.C.B., D.Sc., Sc.D., D.C.L., F.R.S., *obituary*, 1000
North London Exhibition Trust prizes, award of, 489; annual report, 743
Northern territory of Australia, *paper* by David Lindsay, 386

O.

Oakley, Harold, appointed scrutineer, 734
Oats, winter, 943
OBITUARY:—
Annual report, 747
Baynes, Alfred Henry, 81
Buxton, Sir Thomas Fowell, Bt., G.C.M.G., 1015
Chisholm, Robert Fellowes, F.R.I.B.A., 697
Chrimes, Charles Edward, 154
Crosthwaite, Sir Charles Haukes Todd, K.C.S.I., 683
do Nascimento, José Custodio Fernandes, 610
Ewing, William, 232
Foster, Bernard Le Neve, J.P., 348
Glantawe, Lord, 818
Gooday, John Francis Sykes, 186
Harris, Jonathan James, 683
Hartley, Sir Charles Augustus, K.C.M.G., M.Inst.C.E., 322
Hederstedt, Henry Burdett, M.Inst.C.E., 610
Hooper, George Norgate, 186
Humphreys-Davies, George, 610
Laidlaw, Sir Robert, 1033
Lamb, Sir John Cameron, C.B., C.M.G., 467
Leigh, Evan Arthur, 787
Lewes, Professor Vivian Byam, 1000
McHardy, David, 818
Noble, Captain Sir Andrew, Bt., K.C.B., D.Sc., Sc.D., F.R.S., 1000
Parsons, John Edward, 667
P[illegible]ck, George Frederick, 667
Rankin, Sir James, Bt., 534
Roberts, Sir Owen, M.A., D.C.L., LL.D., 168
Rothschild, Lord, G.C.V.O., 484
OBITUARY (*continued*).—
Sang, Alfred, 41
Seely, Sir Charles, Bt., 534
Smith, Samuel George, M.A., D.D., LL.D., 501
Spicer, James, 322
Travers, John Amory, 698
Van Deventer, Conrad Theodor, 975
Waring, Henry Robert, M.Inst.C.E., 818
Willett, William, 381
Ogilvie, Dr. F. G., C.B., *disc.*, Britain and Germany in relation to the chemical trade, 57; *disc.*, the state and the fisherman, 529
Oil and concrete, 974
———— gas in North America, prospecting for, by Chas. N. Gould, 721
— bearing nut in Philippines, 800
— (Chinese wood) in Florida, 924
— (geranium), production of, 382
— in China, 933
—, separating from water of condensation, 905
— stains on cloth, 907
— tank-ships, 725
— *see also* "Fuels, motor"
Oils (essential) of Réunion, 427
———, their production and manufacture, *Cantor Lectures* by F. Mollwo Perkin, Ph.D., F.I.C., F.C.S., M.Inst.P.T., 837, 853, 869; *syllabus*, 156
Olden, Charles, emeralds: their mode of occurrence and methods of mining and extraction in Colombia, 685
Olds, William C., utilising cotton stalks, 580
Onion, the, 716
Opal discovery in South Australia, 781
Orange trade and industry, Spanish, 953
Organisation, by H. S. Hele-Shaw, D.Sc., LL.D., F.R.S., 947
Ormandy, William Reginald, D.Sc., F.C.S., presentation to, of medal for his paper on motor fuels, with special reference to alcohol, 16; *paper*, Britain and Germany in relation to the chemical trade, 47
Owen Jones prizes, annual report, 742; list of awards, 773
Oxyacetylene process and life-saving, 1002

P

Painters' colours and materials, 566
Painting, portrait: the technique of the great masters, *paper* by the Hon. John Collier, 189
Palm kernel cake and meal, 836
————, tali-pot, 468
Panama, hardwoods of, 316; *letter*, Frank Tiffany, 466
————, hats, 161, 769
———— (*see also* "Canal, Panama")
Paper-making materials, the empire's resources in, *paper* by S. Chas. Phillips, M.S.C.I., 613
Paper pulp, manufacture in Mysore, 813
————————, papyrus for, 772
————, trade, Japan, 892
————, uniforms, 868
————, utilising cotton stalks for, 580
Parker, C. Sandbach, *disc.*, sugar and the war, 268
Parkin, George R., C.M.G., LL.D., D.C.L., *chair*, expansion of British industry after the war, 220
Parsons, John Edward, *obituary*, 667
Parsons, Hon. Richard Clere, M.A., elected member of council, 261
Parsons, S. G., *disc.*, Indian indigo industry, 126
Patent law reform, *paper* by John William Gordon, K.C., 356; *letter*, G. G. M. Hardingham, 425; *letter*, Sir Philip Magnus, M.P., 445
————————, Swiss, 533
Patterns, German, 786
Peach, Harry, *letter*, design and industries exhibition at Goldsmiths' hall, 641
Peanuts in Northern Argentina, 679
Pearl fisheries, American, 712
Peat in Italy, utilisation of, 162
Peddie, R. A., presentation to, of medal for his paper, the history of colour printing, 16; *Cantor Lectures*, history and practice of the art of printing, 101, 129, 142, 158; *syllabus*, 2

Peinture, l'evolution de l'ecole Belge de (1830-1900), *Aldred Lecture* by Paul Lambotte, 469
Pennell, Joseph, *disc.*, British lithography in 1915, 253
Perkin, F. Mollwo, Ph D., F.I.C., F C S, *paper*, the Indian indigo industry, 117; *Cantor Lectures*, oils, their production and manufacture, 837, 853, 869; *syllabus*, 156
Perks, Sir Robert William, Bt., presentation to, of medal for his paper on the Montreal, Ottawa, and Georgian Bay canal, 17
Perley, the Hon. Sir George, K C.M G., *chair*, the empire's resources in paper-making materials, 613
Persian Gulf, England and the, 312
——— in 1913-14, 711
Peter Le Neve Foster prize, annual report, 747; offer, 837
Petrograd to London, new route, 170
Petroleum, origin of, 852
Philipps, Sir Owen, K.C.M.G, *chair*, the economic development of British East Africa and Uganda, 209
Phillips, Captain Charles E. S., F R S E, *chair*, industrial uses of radium, 490
Phillips, S. Chas, M S C I., *paper*, the empire's resources in paper-making materials, 613
Photography, new two-colour process, 421
Pibel, W. H, *disc*, the state and the fisherman, 527
Piece-goods tickets, Hindu, 1030
Piedmont: its agriculture and industries, 21
Pigments, testing, for permanence of colour, *paper* by Sir William de W. Abney, K C B, D C L, D Sc, F R S, 85
Poel, William, *paper*, Shakespeare's profession, 325
Pollen, Dr John, C I E, *disc*, the utilisation of solar energy, 565; the Russian soldier, 815
Pollock, George Frederick, *obituary*, 667
Portrait painting: the technique of the great masters, *paper* by the Hon John Collier, 189
Ports, growth of three great Flemish, 862
Postcards, "defenders of the Empire," 323
Potash in the Philippines, 908
——— salt supplies, 99
———, world's, 976
Potterton, T, *disc*, measurement of efficiency of domestic fires, 579
Poultry as farm stock, 111
——— industry in the Philippines, 679
Press, two-thousand ton forging, 152
Preston (Carter), polychrome models of, 817
Price maintenance, systems of, 1015
Price, W E, *disc*, uses of coal gas for industrial purposes, 420
Printing, history and practice of the art of, *Cantor Lectures* by R A. Peddie, 101, 129, 142, 158; *syllabus*, 2

PRIZES:—
North London Exhibition Trust, award to students of Northampton Institute, 489; annual report, 743
Owen Jones, annual report, 742; list of awards, 773
Peter Le Neve Foster, annual report, 747; *notice*, 837
Stock, annual report, 743

Provisions (prices of) on French Riviera in war time, 42
Prynne, R. R, *disc*, the state and the fisherman, 528
Pyrometry, recent progress in, *paper* by Chas. R. Darling, A R C Sc I, 590; *letter*, C R. Darling, 946

Q.

"Quarterly Review" and British charities, 111
Quebracho, hides and tannin extract of, *letter*, Kinsley D Doyle, 98
Queensland mineral industry, 820
Quetta, military academy at, 644
Quicksilver in Italy, 426
Quinine in Italy, production of, 379

R.

Rackham, Arthur, *disc*, testing pigments for permanence of colour, 92
Radium as a fertiliser, 958
———, industrial uses of, *paper* by T. Thorne Baker, 490
Rags, domestic, 787
Rails (125 lb. per yard) for Pennsylvania railway, 665
Railway, Calais Hankow, 924
———, Canadian Pacific, 30, 181
——— coach, petrol, 865
——— earnings, Indian, 580
——— gauge, the war and, 565
———, high-speed electric, 922
Railways, abolition of level crossings on American, 780
———, Australian transcontinental, 111, 608
———, in British Columbia, 608
——— large contracts for rolling stock in Italy, 202
Ramsay, Sir William, K C B., LL.D, Sc.D., F R S, *chair*, the supply of chemicals to Britain and her dependencies, 25
Rankin, Sir James, Bt., *obituary*, 534
Reading-room, contributions to, 1035
Reay, Right Hon Lord, K T., G.C.S.I, G C I.E., *disc*, Basra and the Shatt-ul-Arab, 519
Recruits (technical) for Royal Engineers, 731
Reduction gear for battleships, 922
Redwood, Sir Boverton, Bt, D Sc, F R S E, vote of thanks to chairman of council, 17; *disc*, expansion of British industry after the war, 230; annual meeting, 750
Refractory materials and the war, by Alfred B. Searle, Ph.D., 201
Refugees' committee, work of the war, *paper* by Lady Lugard, 429
Reid, Donald N, *disc*, Indian indigo industry, 126
Reid, Right Hon. Sir George Houston, G C M.G, D C L., K C, *chair*, the economic position of Germany, 303; *chair*, the northern territory of Australia, 386
Reid, Walter F, *disc*, the supply of chemicals to Britain and her dependencies, 35; *disc*, Britain and Germany in relation to the chemical trade, 57; *disc*, patent law reform, 377; *disc*, the utilisation of solar energy, 564
Reindeer in Alaska, 184
Reinforced concrete bridges, 63, 139
——— tramway sleepers, 958
——— tunnel in America, 151
Resonator differential, 756
Rhodes, E H, *disc*, work of the war refugees' committee, 439
Rhodes scholars from Greater Britain, 281
Rhodesia, responsible government in, 40
Rice production in Spain, 62
Rifle ranges, lighting of, 772
Rio Grande do Sul, industries and commerce of, 442
Road surfaces in the Federated Malay States, 987
Roberts, Adair, *disc*, Britain and Germany in relation to the chemical trade, 57
Roberts, A Wynter, *letter*, Indian indigo industry, 127
Roberts, Sir Owen, M A, D C L, LL D, *obituary*, 168
Roberts (Lord) memorial fund, 350
Rogers, W S, presentation to, of medal for his *paper* on the modern poster, 16
Roles, F Crosbie, *disc*, the empire's resources in paper-making materials, 636
Rolfe, B H, *disc*, industrial uses of radium, 497
Rose water and attar of roses, Persian, 82
Ross, E. Halford, M R C S., presentation to, of medal for his *paper* on house-flies and disease, 16
Rotherham, Lord, *chair*, the textile industries of Great Britain and of Germany, 173
Rothschild, Lord, G C V O, *obituary*, 484
Rotterdam, increase of shipping at, 258
Royal fellows, honorary, annual report, 746
Rubber coagulant, coconut-water as, 259
——— cultivation in British Guiana, 447
——— curing process, 790
———, determining total sulphur in, 781
——— paving, 836
Russia, power resources of, 950
———, trade conditions in, 1002
Russian soldier, by Dr. J Pollen, C I E, 815

S.

Salt in Oklahoma, 255
Sanderson, John, *disc.*, decorative textile industries and the designer's relation thereto, 281

Sanderson, Lord, G.C.B., K.C.M.G., *chair*, portrait painting, 189; *chair*, *Aldred Lecture*, l'évolution de l'école Belge de peinture (1830–1900), 469; *chair*, Constantin Meunier et les sculpteurs belges de son temps, 669
Sang, Alfred, *obituary*, 41
Scammell, E. T., *disc.*, expansion of British industry after the war, 231
Science in the war and after the war, by Professor J. A. Fleming, F.R.S., 977
"Scientific American" anniversary number, 755
Scott, M. H Baillie, *Cantor Lectures*, house building: past and present, 989, 1004, 1019; *syllabus*, 351
Sculpteurs belges, Constantin Meunier et les, *Special Lecture* by Paul Lambotte, 669
Searchlight of moderate range, 232
Searle, Alfred B., Ph.D., refractory materials and the war, 201
Seed, method of testing corn for, 379
Seely, Sir Charles, Bt., *obituary*, 534
Seeth manure, 987
Sericulture in Italy, decline of, 680
Sessional arrangements, 1914–15, 1; 1915–16, 1003
Sewage treatment, new, 880
Shakespeare's profession, *paper* by William Poel. 325
Shaw, Bernard, *disc.*, Shakespeare's profession, 336
Shipbuilding in Italy, 447
———, world's, 535
Siberia, forests of, 836
——— (northern), sea route between England and, 254, 973
———, trade channels, 958
Signalling (submarine), latest developments in, 80
Silk and silkworm industry in China, 943
—— culture in Spain, revival of, 165
—— industry of Bulgaria, 752
——————— Syria, 254
——, sewing, 641
Silkworms, new method of hatching, 467
Simnett, W., *disc.*, the state and the fisherman, 528
Simpson, C Liddell, *disc.*, the utilisation of solar energy, 564
Simpson, Professor W. J, C.M.G, M.D., *disc*, British East Africa and Uganda, 219
Sindall, R. W., *disc.*, the empire's resources in paper-making materials, 635
Slater, John, F.R I.B A. *disc*, domestic metal work of the eighteenth century, 77, *disc*, measurement of efficiency of domestic fires, 578
Smith, Sir Cecil Harcourt, *disc*, decorative textile industries and the designer's relation thereto, 282, 283
Smith, Samuel George, M.A., D.D., LL.D., *obituary*, 501
Snow as a Canadian asset, 285
Soap, China, 986
—— in the Red Sea market, openings for, 23
Solar energy, utilisation of, *paper* by A S. E Ackermann, B.Sc.(Eng.), A.M.Inst.C.E., 538; *letters*, W. H. Massey, G. E. Jones, and D. R. Broadbent, 584–5
Sommerville, David, B.A., M.Sc., M.D., *Cantor Lectures*, foodstuffs. 893, 909, 925, 937
Song, how to sing a, *Juvenile Lectures* by H. Plunket Greene, 141, 157
Souslik or prairie marmot, 836
South Africa and the Indian question, 500
Span, longest simple truss, 1031
Spicer, James, *obituary*, 322
Spitzbergen in 1914, 982
Steamers (lake) for Atlantic trade, 609
Steel manufacture in Australia, 464, 974
—— (special) for rails, 1032
Stock prize, annual report, 743
Straits Settlements, trade of, by George d'Almeida, 877
Strange, Edward F., R.E. (Hon.), presentation to, of medal for his paper on Japanese colour-prints, 16
Straw braid and straw hat industry in China, 350
Submarine, battleship *versus*, 80
——— boat, early, 99
———, development of the, 232
——— signalling, 607
Substitutes, German, 533
Sugar and the war, *paper* by Edward R. Davson, 262
Sugar, Cuban, 732
—— industry in the Philippines, 835
—— mill machinery for West China, 751
——, nipa palm, 139
Sullivan, E. J., *disc.*, British lithography in 1915, 253
Sun, *see* "Solar energy, utilisation of"
Surgical instruments, Russia's, 427
Sutton, Martin H. F., *disc.*, industrial uses of radium, 496
Swiney lectures on geology, 986
Swinton, Alan A. Campbell, *disc.*, patent law reform, 376
Swiss postal statistics in war time, 852
Switzerland, industrial activity in, 644
Sydney harbour bridge and connecting railways, 151, 231
Syria, silk industry of. 254

T.

Tanning industry of Philippines, 921
Tapestries and map-making, *letter*, Alan S. Cole, C.B., 40
Taylor, H. B., M.Inst.C.E., *letter*, economic development of British East Africa and Uganda, 257
Taylor, William T., *letter*, munition metals, 851
Tea from new sources, 529
——, Indian, Ceylon and Java, in 1914, 154
Telephone across America, 565
——— system in Italy, 286
———, train dispatch by, 665
——— troubles in the tropics, 667
Telephones, field, *lecture* by Charles R. Darling, A.R C Sc I, F.I.C., *notice*, 789; *lecture*, 881
Terry, Lieut.-Colonel F. S., *disc*, tribes of the Brahmaputra valley, 301
Teuton colony in Italy, 833
Textile industries (decorative) and the designer's relation thereto, *paper* by Arthur Wilcock, 271; *letters*, J D Crace, Chas. A. Eva, A.R C.A, and W G. Paulson Townsend, 320–1; Arthur Wilcock, 346; R H Garton, 348; Eric Newman, 348; R. E. Green, 381, Clarence Mawson, A R.C A, 424
———, development of, 60. 136, 204, 318, 443, 532, 639, 713, 785, 850, 906, 955, 1014
——— of Great Britain and of Germany, *paper* by J. A. Hunter, 174
Textile institute, 640, 1014
—— machines, demand upon, 713
—— production in Korea, 924
———, the war and, 713
—— research work, 714
—— trade, conditions in Germany, 850
———, current conditions in, 906
———, labour supply, 850, 906
——— —, technical progress, in, 850
—— workers, industrial habits of, 532
Textiles, export trade, 639
——, marketing troubles 714
——, reduced imports, 136
——, technical progress in, 640, 850
Theatrical profession, *see* "Shakespeare's profession"
Thomas, Carmichael, *disc.*, portrait painting, 200; *chair*, British lithography in 1915, 247; *disc.*, the empire's resources in paper-making materials, 636
Thomson, Professor J. M., F.R.S., *chair*, the supply of chemicals to Britain and her dependencies, 35; *disc.*, testing pigments for permanence of colour, 91
Thomson, Professor Sir Joseph John, O.M., D.Sc., LL.D., F.R.S., Albert medal awarded to, 613
Thornton, H. M., M.I.Mech.E., *paper*, the uses of coal gas for industrial purposes, 401; silver medal awarded to, for his paper, 742
Thrashing machines in Italy, 892
Thymol, manufacture of, 170
Tiffany, Frank, *letter*, the hardwoods of Panama, 466
Tilden, Sir William A., D.Sc., LL.D., F.R.S., *paper*, the supply of chemicals to Britain and her dependencies, 26; *disc.*, Britain and Germany in relation to the chemical trade, 56; silver medal awarded to, for his paper, 742
Timber in British North Borneo, 765
——— resources of Cuba, 350
Tin smelter in Chile, 756

Tobacco crop of Cavalla district, 908
———, ginseng, and cotton cultivation in Korea, 906
———, Indian, 696
——— output, Argentine, 987
Torpedo, Leon, 1031
Townsend, W. G. Paulson, *letter*, decorative textile industries and the designer's relation thereto, 321
Toys, artistic, 97
—— in Spain, manufacture of, 382
Trade (Indian) and the war, *paper* by Sir Charles H Armstrong, 645
Travers, John Amory, *obituary*, 698
Trevor-Battye, M. A., F.L.S , note on photographs of scences in Nepal, 243 ; *letter*, 247
Trimmings and embroidery, British. *letter*, F Edith Giles, 23
Trustee, public, 502
Tunnel, Mont d'Or, 801
Tunnelling by machinery in the Maritime Alps, 60
Turbine-electric propulsion for battleships, 802
———, gas, 728
———, Hutson Ford, 346
Turkeys, 110
Twists (contrary) in textiles, 319

U.

Uganda, cotton cultivation in, 17
——— economic development of British East Africa and, *paper* by Major E. H. M. Leggett, R E , D S O 209 . *letter*, H B. Taylor, M Inst.C E., 257
Umney, John Charles, F.C.S., presentation to, of medal for his paper on perfumery, 16
United Provinces, India, industrial development of, 831
——— States, British subjects in, 113
Universités françaises aux universités des pays neutres 37

V.

Van Deventer, Conrad Theodor, *obituary*, 975
Vanilla plant, 987
Vegetarian diet, quantity of food required for, 115
Veterinary work in India, 945
Victoria and Albert Museum, 62, 787
Villiers-Stuart, Mrs. Patrick, presentation to, of medal for her paper on Indian water-gardens, 17
Vintage in France, 1914, 206
——— Italy, 1914, 344
Viticulture in Peru, 481
Volcanic ash on the great plains of North America, by Chas. N. Gould, Ph D., 94

W.

Waldstein, Sir Charles, Litt.D , Ph.D., *chair*, decorative textile industries and the designer's relation thereto, 271
Walker-Tisdale, C. W., dairy industry of Great Britain, 107
Wallpapers and decoration, 22
Walton, Sir Joseph, Bt., M.P., *disc* , Basra and the Shatt-ul-Arab, 518
War conditions in textile trades, 785
———, expansion of British industry after the, *paper* by Octavius Charles Beale, 221
———, Indian pamphlets on, 1001
——— trade and the, *paper* by Sir Charles H. Armstrong, 645
——— journal, Maharanee's, 1033
——— memorials and rolls of honour, 379
———, modern munitions of, *Fothergill Lectures* by Professor Vivian B. Lewes, F.I.C , F.C.S , *notice*, 701 ; report, 821
War refugees' committee, work of, *paper* by Lady Lugard, 429
———, science in the war and after, by Professor J. A. Fleming, F.R.S., 977
Waring, Henry Robert, M Inst C E , *obituary*, 818
Wasps, destruction of, *letter*, A. H. Mitchell, 891
Waste substances in Italy, utilisation of, 771
Watch crystal industry, Japanese, 924
Water for troops, sterilisation of, 868
——— power in Norway, 1031
Watson, David Milne, *chair*, uses of coal gas for industrial purposes, 401
Wattle-bark supplies of British colonies, 753
Weights and measures computor, 382
Welding, electro-percussive, 152
West Africa, technical education in, 1002
Western, R. W., *disc* , the utilisation of solar energy, 563
Wheat forecast, Indian, 771
——— in Burma, 567
——— Egypt, 892
——— position and prospects Commonwealth, 39
———, "Pusa 12," 486
——— (spring) growing of, 378
——— supplies, 788
Wheatley, H. B., D.C L. F S A . appointed scrutineer, 734
White (Sir William) memorial fund, 350
Wigglesworth, Alfred, *disc* British East Africa and Uganda, 219
Wilcock, Arthur, *paper*, decorative textile industries and the designer's relation thereto, 271 , *letter*, 346 , *letter*, design at the British industries fair 715
Willett, William, *obituary* 381
Wilson, Sir Harry, K C M G , *disc* British East Africa and Uganda, 218
Wilson, Maurice F J , M Inst C E , *letter*, British East Africa and Uganda, 220
Wireless Station (Punta Arenas), 465
Wolfe-Barry, Sir John, K C B , LL D , F R S , elected a Vice-President of the Society, 805
Women's craftwork, 381
Wood, Sir Henry Trueman, *disc* domestic metal work of the eighteenth century 77 , *disc* , British lithography in 1915, 253 , *disc* , uses of coal gas for industrial purposes, 420 , annual meeting, 750
Woodcarving, school of art, 934, 936
Wool and frozen meat, New Zealand, 99
———, British, 851
———, imperial, 60
——— movements, 785
Workers, transferring, to a new trade, 643

Y.

Yarns, imitation, 137
Yate, Lieut.-Colonel A C , I A (retired), *paper*, the Indian army, 449 ; silver medal awarded to, for his paper, 742
Yate, Colonel C. E., C.S I , C.M.G , M P., *disc* , British East Africa and Uganda, 220 , *disc* , the Indian army, 462
Yerba maté, production of, 998
Young, Wm. A., *paper*, domestic metal work of the eighteenth century, 66 ; silver medal awarded to, for his paper, 742
Younghusband, Lieut.-Colonel Sir Francis E , K.C.I.E , LL D., D.Sc , *chair*, tribes of the Brahmaputra valley, 289

Z.

Zeebrugge, port of, 130
Zeppelin cloth, 444
Zinc factory for Japan, 936

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